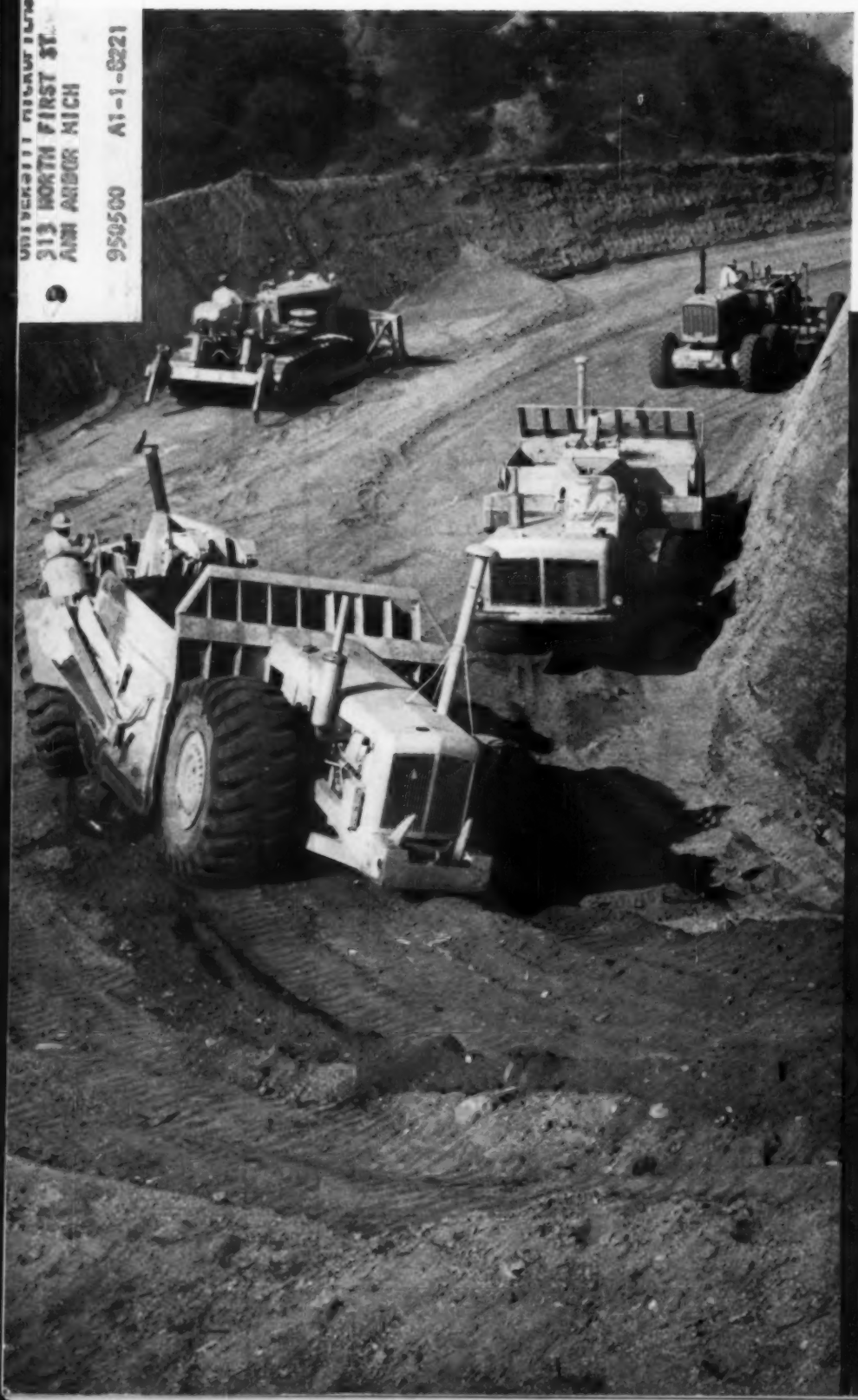
AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

Hydraulics & Pneumatics

UNIVERSITY MICROFILMS
313 NORTH FIRST ST.
ANN ARBOR MICH
950500 A1-1-8221



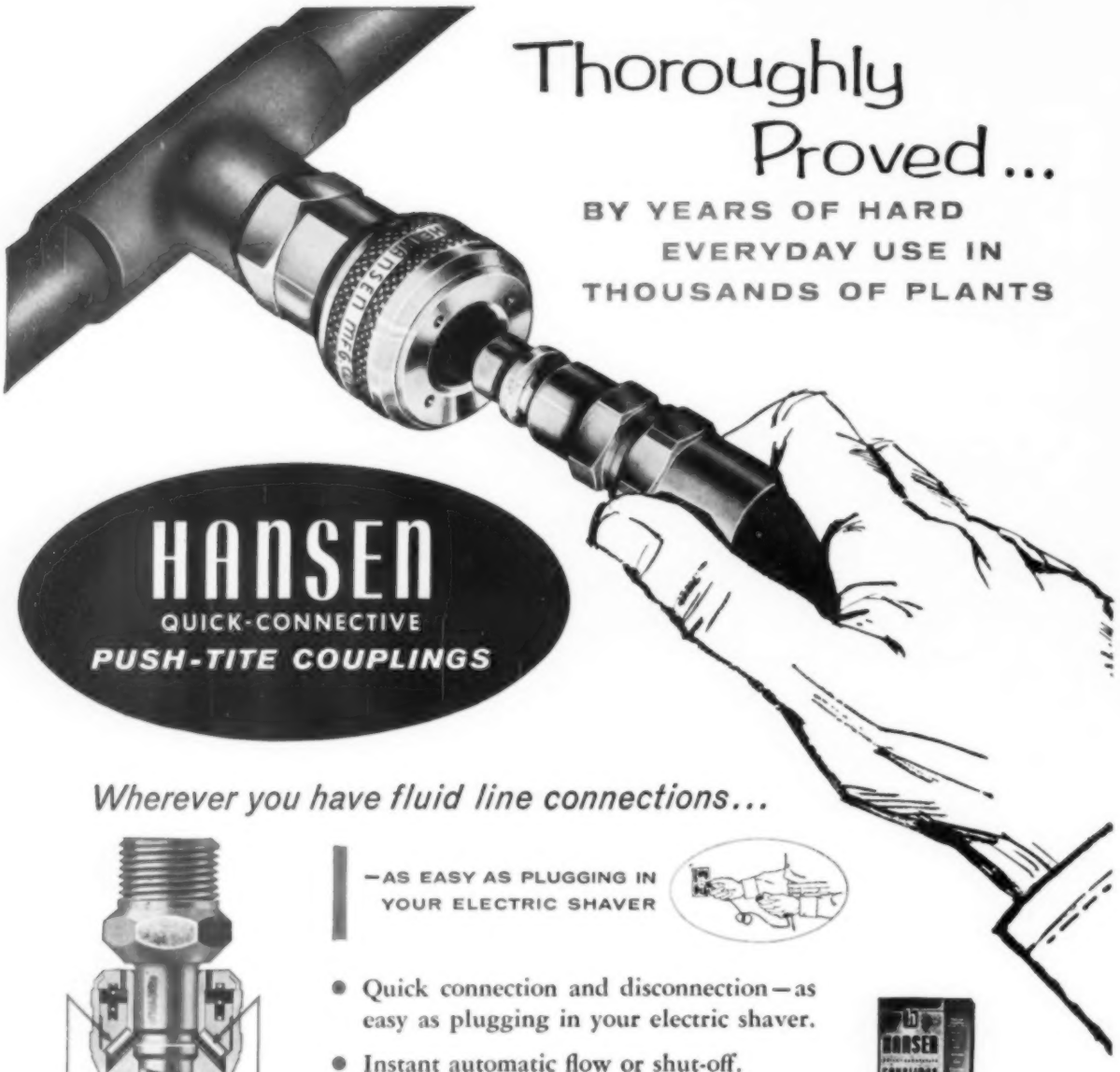
SEPTEMBER 1961

Fluid Power on the move

- Four-Bar Hydraulic Linkage Controls Digging Depth
- Pneumatics on Mobile Equipment
- Hydrostatic Drive Replaces Engine on Earthmover
- Servo System Regulates Implement Depth

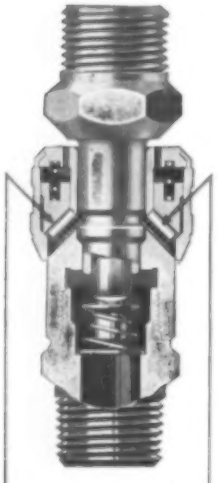
Thoroughly Proved...

BY YEARS OF HARD EVERYDAY USE IN THOUSANDS OF PLANTS



HANSEN
QUICK-CONNECTIVE
PUSH-TITE COUPLINGS

Wherever you have fluid line connections...



Tamper-Proof Socket Head — with leak-proof, minimum wear, locking device.

—AS EASY AS PLUGGING IN YOUR ELECTRIC SHAVER

- Quick connection and disconnection—as easy as plugging in your electric shaver.
- Instant automatic flow or shut-off.
- Factory assembled socket head cannot be readily damaged—or have component parts lost by casual tampering.
- Locking pins afford large area contact with Plug—reduces wear to a minimum.

Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

Representatives in Principal Cities...See Yellow Pages

SINCE 1915 — QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 35, OHIO

Circle **77** on Reader Service Card

This automatic saw uses three Hanna-Powr Positioners which have a total of 40 limit switches. Positioner housings completely seal the switches from cutting oil and chips. Wiring is self-contained. Positioner 1 senses size of workpiece, Positioners 2 and 3 are for sequencing and cycling. Positioner installation cost 30% of estimated individual cam and limit switch cost.

Start a cam and limit switch COST REDUCTION PROGRAM!

You can cut cam and limit switch costs up to 70% by using the Hanna-Powr Positioner — a compact, dust and water-tight housing containing cam rods and limit switches.

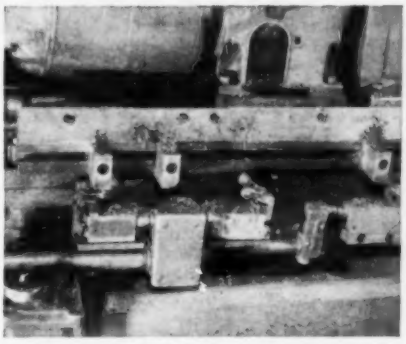
Because the Positioner is a pre-engineered assembly, it saves time used in designing special cams and mountings. Installation costs are cut, too, because it is only necessary to mount one box (4 screws) rather than individual switches and cams. Wiring is greatly simplified. The Positioner housing serves as a junction box—one conduit connection does it.

The switches can be moved easily and locked quickly in place after installation. This speeds set-up time for new jobs and makes pre-calculation of stops unnecessary. Safety is another big advantage—the switches cannot be tripped accidentally.

In addition to lower initial costs —maintenance, replacement, and down-time costs are cut. Switches last longer due to the protection (from dirt, chips, fluids and damage) afforded by the sturdy, extruded aluminum housing.

Use Hanna-Powr Positioners for cycling, sequencing, positioning, sensing and indicating. Many are in use and have been thoroughly tested in a variety of applications. It's a practical approach to automation.

Positioner containing switches and cam rods. Up to 28 switches per foot of travel. Any travel to 8 feet. Takes standard miniature or heavy duty limit switches, single or double throw.



Examine your cam and limit switch costs. $35 to $75 per switch is the cost companies have fixed for designing, machining, installing, wiring, and adjusting limit switches and cams. This photo shows a typical high cost installation where oil, chips and accidental damage cause high failure rates and increased maintenance costs.

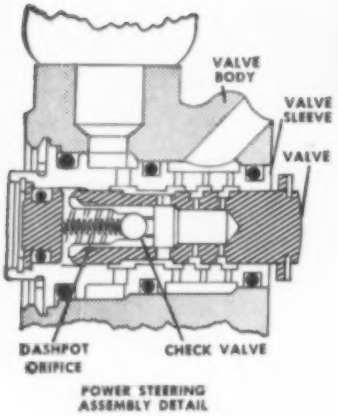
Write for complete catalog or consult Sweets' Product Design File section 9A/HA. Your Hanna Representative will also give you complete information—see the yellow pages under cylinders.

Hanna Engineering Works

174 Elston Ave., Chicago 22, Illinois
AIR AND HYDRAULIC CYLINDERS, VALVES, POSITIONERS

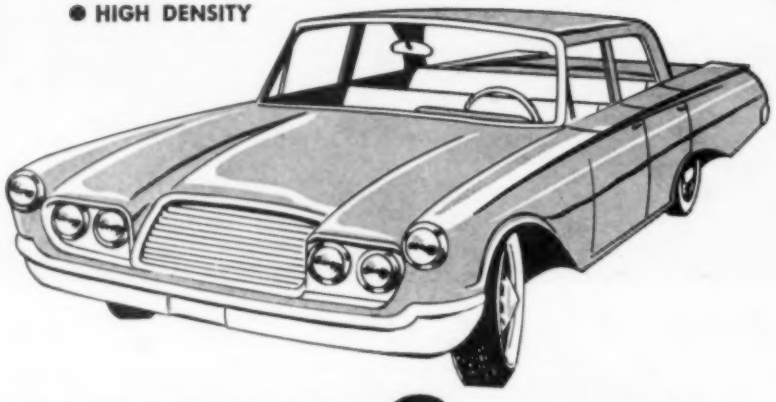
MINNESOTA MR RUBBER

FACTS for FILING on O-RINGS



POWER STEERING ASSEMBLY DETAIL

- EXCLUSIVE INJECTION MOLDED
- HIGH DENSITY



- WEAR RESISTANT
- CUSTOM COMPOUNDS

INJECTION MOLDED O-RINGS give better service in any application

EXCLUSIVE INJECTION MOLDING—This advanced molding technique produces an O-ring with amazingly close tolerances. It also reduces to a minimum variations in part thickness and virtually eliminates flash. Specifying injection molded O-rings for your equipment insures you of top sealing efficiency.

HIGH DENSITY—The higher, more uniform density found in injection molded O-rings increases resistance to abrasion and chemicals. This outstanding toughness and durability means better sealing and longer seal life.

WEAR RESISTANT — Reciprocating, rotary, static or oscillating, no matter what the application, injection molded O-rings resist wear and damage due to extrusion for thousands of cycles longer than ordinary O-rings. They reduce replacement and loss of production due to downtime, making big savings possible.

CUSTOM COMPOUNDS—MR's industrial, standard compounds will give outstanding service under most operating conditions. For those unusual applications, however, you can rely on MR to come up with a special compound designed for you, whether out of a common elastomer or an exotic one like Silicone or Viton A.

ONLY MINNESOTA RUBBER CAN GIVE YOU COMPLETE DESIGN, ENGINEERING AND PRODUCTION SERVICES ON YOUR RUBBER REQUIREMENTS.

FOR MORE INFORMATION ON INJECTION MOLDED O-RINGS

WRITE:

MINNESOTA MR RUBBER

NFPA

DEPARTMENT 122 • 3630 WOODDALE AVENUE
MINNEAPOLIS 16, MINNESOTA

WRITE ON YOUR LETTERHEAD FOR A FREE "MR FACTS FOR FILING" COVER.

Hydraulics & Pneumatics

VOLUME 14/NUMBER 9

SEPTEMBER 1961

THE MAGAZINE OF FLUID POWER

ALLAN E. MORRIS
editor

JACK LOWERY
associate editor

TOBI GOLDOFTAS
associate editor

EDWIN JACOBS
assistant editor

JAY MYERS
assistant editor

BERT BENKENDORF
art editor

HENRY LEFER
eastern editor, New York

SCHOLER BANGS
western editor, Los Angeles

JOHN A. LANKESTER, A.R.Ae.S.
European editor

ALARIC MAUSSER
art director

DEPARTMENTS

10 . . . Fluid Power Lines

12 . . . Letters to the Editor

16 . . . Fluid Power Forum

20 . . . Fluid Power at Work

52 . . . Future Events

56 . . . New Products

74 . . . New Literature

136 . . . Aerospace Component Data

140 . . . Aerospace News

148 . . . Fluid Power Patents

172 . . . Post Scripts of Industry

178 . . . Market Place

183 . . . Advertisers' Index

186 . . . Reader Service Index

Cover photo
Courtesy Euclid Div.,
General Motors Corp.

FLUID POWER ON THE MOVE

Mobile Equipment Hydraulics . . . A Design Primer
Part 3—Valves 81
By Russ Henke

Four-Bar Hydraulic Linkage Controls Trencher's Crumbing Shoe 86
By Henry L. Meyer and Fred R. Wilhelm

Hydrostatic Drive Replaces Engine on Earthmover 91
By Keith Brownfield

Hydraulic Servo System Regulates Implement Depth 94

Component Designs for Shovel's Clutch System 107
By Paul A. Chalupsky

BASIC FLUID POWER DESIGN

Sewage Fittings to Teflon Hose in Your Plant 104
By G. P. Karpovich

Dehydrating High-Pressure Gas 113
By Stuart M. Sachs

Principles of Gas Purification 116
By J. R. Clark, Jr.

FLUID POWER APPLICATIONS

Two Air Circuits for Cylinder Speed Control 100
By W. C. Thompson

Hydraulic Tests Simulate Plane's Flight Loads 120
By D. S. Morcock and W. M. Law

AEROSPACE SECTION

Hydraulics Helps Handle Helicopters 124
By Albert J. Tolomeo and Edmond R. Vianney

Understanding Contamination
Part 3—How to Reduce Contamination from Components 128
By H. D. Davis

Hydraulics—Whipping Boy for Jet Crashes? 140
By Scholer Bangs

FLUID POWER AT WORK 20

Hydrostatic transmission and Gas Turbine Combine in Advanced Tractor Design . . . NCIH—1961 . . . NFPA Adopts Slogan . . . Fluid Motor Drives Injection Molding Press Screw . . . Hydraulic Motor Drives Concrete Mixer Drum . . . SAE Announces Milwaukee Exhibits, Sessions . . . Fluid Power Helps Dig Coal . . . Modular Plan Used in Gast Lab . . . Firth Cited for Hydrostatic Transmission Work . . . Review of Compressed Air & Gas Handbook . . . Design of an Adjustable Shock Absorber . . . Hydraulic Dozer Converts to Front-End Loader . . . FPS Annual Meeting . . . Hydraulic Power Unit Mounted on Two-Wheel Trailer . . . Air-Controlled Die-Casting Machine . . . Ram Gives Angle Shear Full Power Throughout Stroke

NFPA NATIONAL FLUID POWER ASSOCIATION

FC FRANCHISE CIRCULATION

BPA

copyright 1961 by The Industrial Publishing Corporation

AUTOCLAVE ENGINEERS ERIE, PA.

SPACESAVER
Stainless Steel Valves

Here is a stainless steel tubing valve—precision made yet rugged—which gives you improved performance *plus* savings in space, time and money. The SpaceSaver is more compact and lighter in weight than any other valve of comparable tubing size and pressure rating. Although capable of handling gases and liquids at 12,000 p.s.i., these valves are priced for practical use at all lower pressures. Full port openings—with minimum pressure drop through the valve—are a major advantage. And installation is quick and easy—no threading, swaging, flaring, welding or special tools are required.

AE SpaceSaver Valves are of 316 s.s. construction and are available for ⅛" O.D., ¼" O.D., ⅜" O.D. or ½" O.D. tubing.

Bulletin 257 gives complete information—yours for the asking.

AUTOCLAVE ENGINEERS, INC.

2935 West 22nd Street • Erie, Pa.

Designers and Builders of High Pressure-High Temperature Equipment including: Valves • Fittings • Stirred Autoclaves • Reactors • Pumps • Compressors • Complete High Pressure Package Systems including Instrumentation and Controls.

Circle **15** on Reader Service Card

Hydraulics ℗ Pneumatics

THE MAGAZINE OF FLUID POWER

BUSINESS STAFF

ROBERT D. SHATTUCK *business manager*
JAY MYERS . . . *production manager*
N. G. KISER . *circulation manager*
ROBERT GAUVIN . . . *reader service*

FRANCHISE DEPARTMENT

HAROLD ROBERTS . . . *representative*
RICHARD PLANCK . . . . . *production*

SALES OFFICES

Cleveland 15
812 Huron Rd., SU 1-9620
ROBERT G. JOSEPH

New York 17
Rm. 835, 60 E. 42 St., MU 7-3420
LEE HAAS, *vice-president*
DAN J. ROWLAND

Chicago 11
Rm. 704, 520 N. Michigan
WH 3-1655
CHARLES F. GEYER, *vice-president*
SAM TRACY

Los Angeles 57
Cranada Building
672 S. Lafayette Park Pl.
DU 7-5104
ALAN T. CAZIER, *manager*
PAUL MANNING

London, S. W. 1
36 Victoria St.
SULlivan 6072
JOHN A. LANKESTER, *manager*

SUBSCRIPTIONS in U.S. and possessions; $7.00, 1 year; $12.00, 2 years. Canada: $8.50 per year. Foreign: $10.00 per year, payable in advance in U.S. funds. U.K.: £3.5.0 per year payable in Sterling to London office. Single copy price: 75 cents.

Out-of-print copies of HYDRAULICS & PNEUMATICS Magazine are available in complete volumes as positive microfilm copies from: University Microfilms, 313 N. First Street, Ann Arbor, Michigan.

published monthly by

The INDUSTRIAL PUBLISHING CORPORATION

812 Huron Rd., Cleveland 15, Ohio
LESTER P. AUBPACH . . . *president*
EDWIN M. JOSEPH . *executive v.p.*
PAUL ROLNICK . . . *vice president*
N. N. GOODMAN, JR. *vice president*
LEE HAAS . . . . . *vice president*
CHARLES F. GEYER . *vice president*
TOM DEMPSEY . . . *asst. sec. treas.*

AFFILIATED PUBLICATIONS:

Material Handling Engineering (formerly Flow), Handling & Shipping, Modern Office Procedures, Occupational Hazards, Power Transmission Design, Precision Metal Molding, The Refrigeration & Airconditioning Business, Welding Design & Fabrication.

Published monthly. Controlled circulation postage paid at Pontiac, Illinois. Please return 3579 forms to 812 Huron Road, Cleveland 15, Ohio. Printed in U.S.A.

USEFUL LITERATURE

NEW CATALOG FOR REPLACEMENT LINE OF ANCHOR HYDRAULIC HOSE ASSEMBLIES, COUPLINGS, HOSE AND FITTINGS

For better, faster service for users of fluid power equipment requiring replacement hydraulic components, the Anchor Coupling Co. Inc. consolidated catalog—No. D-2 describes the complete *replacement* line of Anchor Pressed-On Hydraulic Hose Assemblies, together with Anchor Reusable Couplings, Hose and Fittings. These Anchor products are carried in stock for immediate pick-up or delivery from Anchor distributors.

Prepared for quick reference, selection and ordering, catalog No. D-2 shows the comprehensive Anchor line of Pressed-On Hose Assemblies.

Anchor Super-Spiral Wire Reinforced High Pressure Hydraulic Hose Assemblies with Pressed-On Couplings, offering the highest burst and working pressures available in hydraulic hose assemblies, are completely described, with detailed specifications.

In addition, the new Catalog shows Anchor high pressure Pressed-On Hydraulic Hose Assemblies for extra strength Two Wire Braid, standard Three Wire Braid, and extra strength Three Wire Braid Hose.

Featured are Anchor's high pressure Two Wire Braid hose (SAE 100R2) assemblies with Pressed-On, Clamp-Type or Coverstrip Reusable Couplings, together with Anchor's medium and low pressure One Wire Braid (SAE 100R1) Assemblies with Pressed-On Couplings or Reusable Couplings. For non-flammable hydraulic fluids (Phosphate Esters), Anchor's High Pressure Two Wire Braid Hose Assemblies with Pressed-On Couplings are recommended.

Medium and low pressure One Wire Braid Cotton Cover Hose (Style QW-SAE 100R5) and One Wire Braid Rubber Cover Hose (Style QWR) Assemblies with Duloc Reusable Couplings are illustrated.

Described in detail are Anchor Max-Flo Hi-Burst Two Rayon Braid Hose (Style HR-SAE 100R3) and standard Style R Two Rayon Braid Hose Assemblies with Pressed-On, Clamp-Type and Reusable Couplings.

For suction, low pressure or gravity flow hydraulic lines, Anchor Max-Flo Spiral Wire Reinforced Suction Hose (Style SW-SAE 100R4) Assemblies with Pressed-On or Clamp-Type Couplings are shown.

Also illustrated are Anchor Style PR Rubber Cover 1-Cotton Braid Hose and Style PQ Cotton Cover 1-Cotton Braid Hose Assemblies with Anchor Hold-Fast Couplings for low pressure automotive, marine and industrial applications.

The Couplings section of Catalog No. D-2 gives detailed specifications for Anchor high, medium and low pressure Clamp-Type Reusable Couplings and Coverstrip Reusable Couplings for Two Wire Braid hose (SAE 100R2) and One Wire Braid Hose (SAE 100R1); DULOC Reusable Couplings for Style QW (SAE 100R5) and Style QWR hose; Reusable Couplings for Hi-Burst and standard Two Rayon Braid, Style HR (SAE 100R3) and Style R hose.

Described in detail are Anchor 4-Bolt Split-Flange "O" Ring Head Clamp-Type Couplings for use with the above mentioned hose. Also included are Anchor Split Flanges and components.

Anchor's Hold-Fast Reusable Couplings, in a wide variety of styles and sizes, are described.

The Anchor line of Adapter Unions, Adapters, Pipe Fittings and SAE Boss Fittings for hydraulic and industrial uses, with the largest variety of three combinations—standard, JIC, SAE, etc.—is included in the new catalog.

Copies of Anchor No. D-2 Catalog are available at Anchor distributors, or can be obtained by writing direct to Anchor Coupling Co. Inc., 355 North Fourth St., Libertyville, Illinois.

Circle **10** on Reader Service Card

When stamped on Anchor hydraulic components . . . the Anchor emblem is your definite assurance of constant, uniform quality in design, engineering and manufacture . . . and *complete reliability* in hydraulic transmission lines. Anchor fluid power components eliminate equipment downtime . . . production delays . . . idle manpower.

Anchor's comprehensive line of Hydraulic Hose Assemblies with Pressed-On, Reusable, Clamp-Type or 4-Bolt Split-Flange "O" Ring Head Couplings . . . Hydraulic Hose . . . Adapters, Adapter Unions, Pipe Fittings, and SAE Boss Fittings with the greatest variety of thread combinations — pipe, J.I.C., SAE — give long life, uninterrupted trouble-free service . . . with minimum maintenance.

Today . . . as it has been for over 20 years . . . Anchor is *first choice* among original equipment manufacturers.

Send for the Condensed Catalog . . . to help you choose the *right* Anchor hydraulic component for your equipment.

ANCHOR HOSE ASSEMBLIES with Pressed-On Couplings for maximum working pressures from 12,500 PSI to 100 PSI.

ANCHOR REUSABLE, CLAMP-TYPE, DULOC and/or HOLD-FAST COUPLINGS for pressures from 5000 PSI to 100 PSI.

ANCHOR 4-BOLT SPLIT-FLANGE "O" RING HEAD COUPLINGS for pressures from 3500 PSI to 100 PSI.

ANCHOR ADAPTERS, ADAPTER UNIONS, PIPE FITTINGS, SAE BOSS TYPE FITTINGS in variety of styles and sizes, and thread combinations.

Andy Anchor says: *"Remember . . . the Anchor emblem is our 'Pledge of Performance'. . . always! You increase the salability of your equipment with Anchor fluid power components."*

ANCHOR Coupling Co. Inc.

354 North Fourth Street, Libertyville, Ill.
Branch Plants: Dallas, Tex., Plymouth, Mich.

Circle **11** on Reader Service Card

MARVEL

FOR DEPENDABLE PROTECTION

Synclinal SUMP TYPE

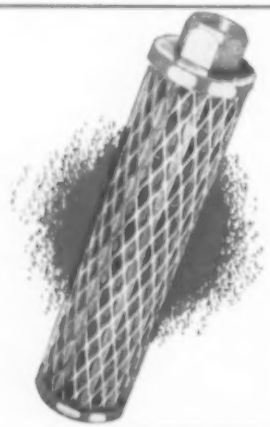
CAPACITIES:
5—8—10—20—30—50—75 and 100 G.P.M.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

CONNECTIONS:
Coupling—Male Nipple.

BY-PASS VALVE:
Not Available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.



Tandem Synclinal SUMP TYPE

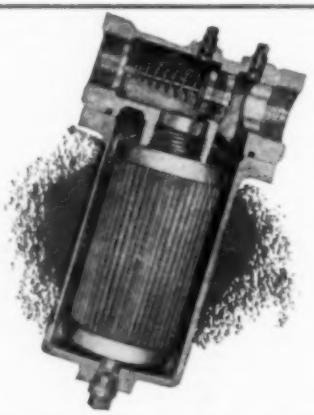
Designed to supply requirements for greater filtering area where installation of two or more single units are not possible due to space limitations in tank.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

CONNECTIONS:
Coupling—Male Nipple.

BY-PASS VALVE Not Available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids and water.



Bonded SUMP TYPE

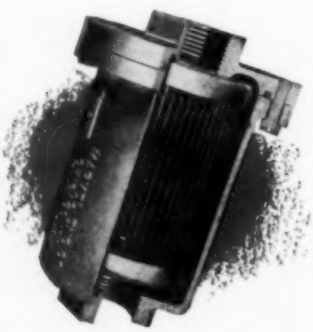
CAPACITIES:
10—20—30—50 and 75 G.P.M.

PIPE SIZES:
1"—1¼"—1½"—2" and 2½".

CONNECTIONS:
Coupling—"O" Ring—Male Nipple.

BY-PASS VALVE:
Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.



SYNCLINAL FILTERS

on all hydraulic and other low pressure circulating systems

Synclinal LINE TYPE

CAPACITIES:
5—8—10—20—30—50—75 and 100 G.P.M.

PIPE SIZES:
¾"—1"—1¼"—1½"—2"—2½" and 3".

BY-PASS VALVE:
Not available.

OPERATING PRESSURES:
Up to 80 p.s.i.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded LINE TYPE

CAPACITIES:
10—20—30—50 and 75 G.P.M.

PIPE SIZES:
1"—1¼"—1½"—2" and 2½".

MOUNTING BRACKET: All sizes are available with provision for mounting bracket, (also for Flange connection with mounting bracket provisions) if desired.

BY-PASS VALVE:
Available with or without.

OPERATING PRESSURE:
Up to 250 p.s.i.

OPERATING TEMPERATURES:
Up to 300° F.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

IN-LINE FILTER

CAPACITIES:
Up to 60 G.P.M.

PIPE SIZES:
(at both inlet and outlet)
¾"—1"—1¼" and 1½" **NPTF.**
1 5/16-12, 1⅝-12 and 1⅞-12 **J.I.C.**

FLANGE CONNECTIONS:
1¼" and 1½"

BY-PASS VALVE:
Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

QUALITY
DEPENDABILITY
EFFICIENCY

QUALITY—All Marvel Synclinal Filters are designed and constructed of the highest quality materials and workmanship to insure maximum protection on all hydraulic and other low pressure circulating systems. *They Meet J. I. C. Standards.*

DEPENDABILITY—The dependability of Marvel Synclinal Filters is attested by the fact that—OVER 900 Original Equipment Manufacturers install them as standard equipment.

EFFICIENCY—Filtering media in all Marvel Synclinal Filters is Monel wire cloth and available in mesh sizes of 20-30-40-50-60-80-100-150 and 200. Stainless wire cloth in these sizes supplied on specification. Before fabrication into Marvel Synclinal Filters, all wire cloth is subjected to rigid inspection at our plant to assure the utmost in filtration efficiency. *Only selected top quality wire cloth is used.*

EASY MAINTENANCE—All Marvel Synclinal Filters can be cleaned easily and thoroughly "on the spot" in a matter of minutes, resulting in the equivalent of a brand new filter, ready for another long period of efficient and dependable service.

Line type filters operate in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY
A phone call will start your shipment on its way TODAY!

For Further Information, Wire, Write or Phone

MARVEL ENGINEERING COMPANY

7227 North Hamlin Ave. • Chicago 45, Illinois • Phone JUniper 8-6023

Please send me information on Marvel Filters as indicated. AH-9

☐ Sump Type ☐ In-Line ☐ For Hydraulic Oil ☐ For Coolants or Lubricants
☐ Line Type ☐ Tandem ☐ Fire Resistant Fluids ☐ For Water

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

this job isn't boring!

No, because Valvair knows that smoothness of surface is directly related to O-ring life . . . to multi-million cycle dependability of valve performance. That's why Valvair is the only manufacturer of O-ring sealed spool-type air control valves who won't settle for a bored finish, no matter how good, for surfaces in contact with main O-rings.

All Valvair Speed King® valve bores are honed to an extremely smooth surface finish of 20 micro-inches or better . . . stems are polished to 10 micro-inches. Each part is checked, prior to assembly, with a surface measuring instrument to be sure it meets Valvair's high standards of surface finish. This painstaking attention to product quality is your guarantee of Valvair performance and service life.

If you stake your reputation on the design, construction or operation of air controlled machinery, can you afford to use less than the best . . . the most dependable control valve components? Your nearby Bellows-Valvair Field Engineer can tell you more about Valvair quality and versatility. Call him today. Or, for more information, write for Bulletin FL-61. Address Bellows-Valvair, Akron 9, Ohio, Dept. AH-961.

Bellows-Valvair

AKRON 9, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION® (IBEC)

8193

...Fluid Power NEWS

OILGEAR 1921 1961 40 Years of Fluid Power

Report No. 11,806 From Oilgear *Application-Engineering* Files

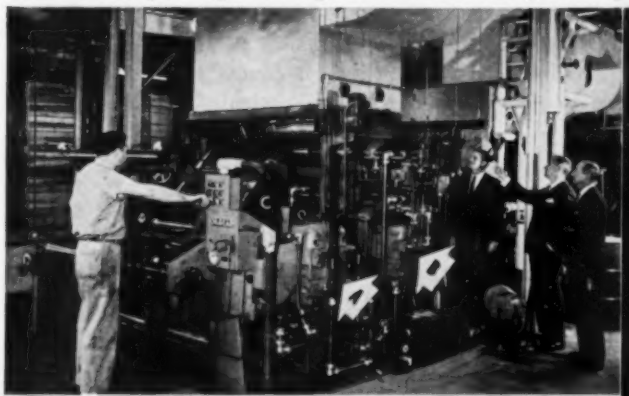
HOW OILGEAR HEAVY-DUTY *Any-Speed HYTAC** DRIVE SYSTEMS ON *Anaconda's* NEW FOIL LAMINATING AND COATING MACHINES HELP SPEED PRODUCTION—CUT COSTS

USER: *The Anaconda Aluminum Company, Louisville, Kentucky, Fair Lawn, New Jersey, Terre Haute, Indiana*

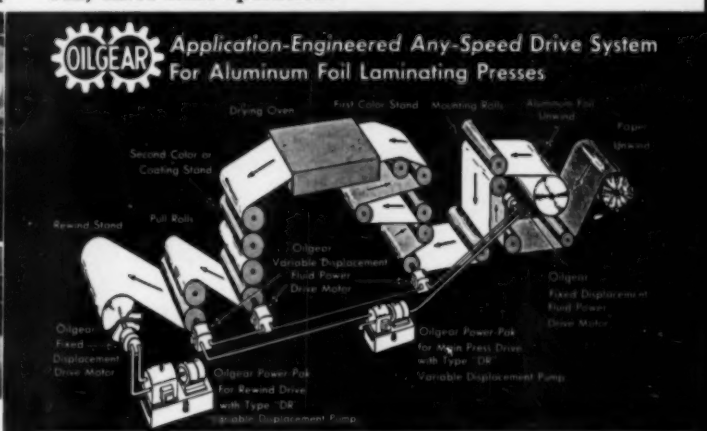
(Machine Builder — New Era Manufacturing Company, Hawthorne, New Jersey — successor to Meisel Press Manufacturing Company, Boston, Mass.)

PROBLEM: Main and Rewind Drive Systems for two, new, high-speed laminators to bond aluminum foil as thin as 0.0002" to paper stock ranging from 15-lb tissue to 0.020" carton and food board. In addition to laminating, these "presses" must simultaneously coat and/or color the foil.

REQUIREMENTS: 1. Accurate, wide range, dependable tension control to accommodate *Anaconda's* complete range of laminating foils and paper stock. 2. Infinitely variable, stepless speed range from 0 to 1000 fpm—capable of an optimum, continuous 850 fpm running speed. 3. Maintain tension accurately in "stall" condition indefinitely without overheating—and then pick up speed smoothly and quickly without snapping the sometimes fragile web. 4. Reduce costs through reduction of scrap, repair parts inventories, and machine downtime . . . operate at nearly three times former production speeds. 5. Must be: compact, to conserve valuable floor space; economical on electric power input; capable of continuous, three-shift operation.



ABOVE: One of Anaconda Aluminum's new, Oilgear-equipped, high-speed foil laminating and coating presses—rewind end—as installed at their Louisville, Kentucky, Laminating Plant. Roll cores—8¾" dia. . . . web width—from 23" to 52" . . . roll diameters—to 60" . . . roll weights—to 4500-lb. Tension range—from ½-lb/in. to 4-lb/in. depending on weight of lamination being processed. Arrows (A), (B)—Oilgear Variable Displacement Drive Pumps. Arrow (C)—one of two pushbutton control stations at opposite ends of the press—3 emergency "stop" buttons are located at other positions.


OILGEAR
Application-Engineered Any-Speed Drive System
For Aluminum Foil Laminating Presses
Drying Oven
First Color Stand
Mounting Rolls
Aluminum Foil Unwind
Paper Unwind
Second Color or Coating Stand
Rewind Stand
Pull Rolls
Oilgear Variable Displacement Fluid Power Drive Motor
Oilgear Fixed Displacement Fluid Power Drive Motor
Oilgear Fixed Displacement Drive Motor
Oilgear Power Pak for Rewind Drive with Type "DR" Variable Displacement Pump
Oilgear Power Pak for Main Press Drive with Type "DR" Variable Displacement Pump

Oilgear's patented *Any-Speed HYTAC** Drives (details not shown above) hold any preselected speed within ±0.1% under constant torque loads—within ±0.5% regardless of load, electric power variations, or temperature and viscosity changes . . . provide cushioned starting, remote jogging and threading . . . smooth, even let-off or build-up tensions . . . constant torque . . . adjustable tension . . . hydrodynamic braking. Applied to center shaft winders, *Any-Speed HYTAC** Drives automatically sense and compensate for changes in overall machine speed, and can automatically provide constant, adjustable, or tapering tension over a 20:1 winding range without dancer or follower rolls.

*HYTAC—A registered Oilgear Trademark

SOLUTION: Oilgear *Any-Speed HYTAC** Main and Rewind Drive and Tension Control Systems—as symbolized in the schematic sketch—above right. These compact, heavy-duty systems have successfully met or exceeded all originally specified requirements in continuous, three-shift, high-speed operation. Oilgear Drives were selected for these new machines because of: 1. The enviable record of maintenance-free long-life in several Anaconda Aluminum Plants. For example—six out of seven original, 300-fpm laminating presses at Louisville are Oilgear-equipped . . . two operating continuously since 1946. These 14-year-old drives—and two others—*have NEVER required maintenance other than oil changes and an occasional drive shaft seal.* The other two Oilgear Drives—installed in 1948—were disassembled three years ago merely for a preventive maintenance check—haven't been "touched" since. 2. Oilgear's accurate, dependable tension and speed control over a wide range—for smooth, precise, trouble-free operation on Anaconda's *entire range* of laminating stocks. 3. Space saving—Oilgear Drives occupy less floor space . . . do not require high-speed blowers for cooling—can hold stall-speed indefinitely without overheating. 4. Economy—in electrical power input, maintenance, virtually eliminate costly machine downtime and spare parts inventories . . . and in many cases—at lower installed cost.

Unbelievable?—Not to Oilgear Users! There are case histories upon case histories on file of machines equipped with *Application-Engineered Oilgear Drive Systems* that are rolling along—efficiently, quietly—with over 20 years of trouble- and maintenance-free service! Some additional *installation-proved* reasons . . . the greater accuracy, precision control of speeds, torques, tensions . . . new economies of operation, installation, and valuable floor space . . . are why more and more Oilgear users in the paper, printing and converting, food and beverage, marine, chemical, pharmaceutical, primary metals, metalworking, textile, rubber, military, and other industries all agree that . . .

for the lowest cost per year . . . it's OILGEAR!

For practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

Phone: Mitchell 5-6715 . . . Direct Distance Dialing Code—414

FLUID POWER LINES

from editor to reader

MOBILE EQUIPMENT—TODAY AND TOMORROW

Not to be outdone by the exotic advances in aerospace technology, or industrial developments in automatic production machines, mobile equipment design has taken some big strides itself in the past few years and promises some even bigger ones in the future. Everyone talks about hydrostatic transmissions and a lot of people are doing something with them.

The article on page 20 shows how far International Harvester has come in joining a hydrostatic transmission to another component that has long held promise for mobile equipment: the gas turbine. The transmission eliminates gear shift, brake, and clutch, and gives a smooth, infinitely variable speed control in both forward and reverse. The constant speed gas turbine eliminates cooling water, uses almost no oil, starts readily at low temperature, and has almost no vibration.

Glide-Aire is the name of a ground effect system being made by Clark Equipment to handle materials by floating them on a cushion of air. In one application the air cushion is created on the bottom of a pallet, so that a man can push several thousand pounds with little effort. Experimental models connect to plant air supply, but Clark is developing a pallet with built-in compressor, air valves, and controls.

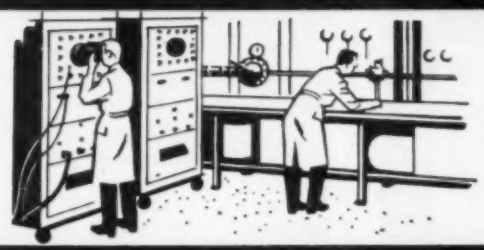
Moving toward the lift truck goal of universal handling, Hyster recently demonstrated its new vacuum handling system that works with anything that can be enclosed in a reasonably tight wrap or carton. The new system has a very high vacuum capacity that builds up faster than anyone thought possible with equipment that fits on a truck. Attachments handle loads with surface vacuum or internal vacuum. For surface, the attachments suck against a solid surface and lift. Internal vacuum requires a bag or wrap around the load. In seconds, the air is drawn out, making the wrap and load into a solid mass.

Mobile equipment design ideas that have already proved themselves in the field are shown in six articles in this issue. Starting with the comprehensive review of valves, you'll learn . . . how Cleveland Trencher designed a cylinder-operated, 4-bar linkage for the crumbing shoe of their trencher . . . where pneumatics is used on mobile equipment . . . how Warner & Swasey replaced an engine with a hydrostatic drive on their Gradall . . . how a servosystem controls traction and implement depth on a British farm tractor . . . and components which Link Belt Speeder uses for smooth clutch control of their shovel crane.

All of which shows that fluid power is on the move.

Allan E. Morris

Editor



Out of the **Ross** research lab has passed the most extensive line of valves in the air control world

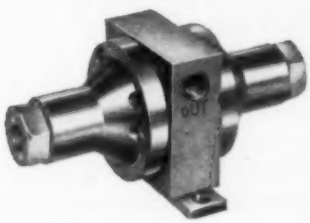
4 fine valves from the Ross valve line

Fast valves manifolded

The PACER 4-way gives 1000 cpm and more, has all JIC features, is built for super long life. Manifold as many as you please. One air supply, one exhaust.

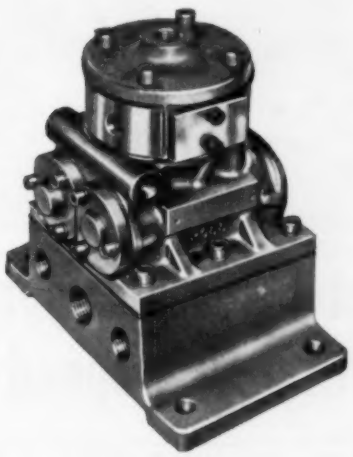
For greater press safety

The Non-Tie-Down valve is designed to protect the press operator's hands. Requires the operator to activate two separate valves continuously during a machine's cycle.



Overriding cam operation

The PCB valve—A ¼" valve with low minimum operating pressure—5 psi to 125 psi—that is fast operating and ruggedly built. Overriding cam activates valve from one direction only.



Air operation with momentary action on a 4-way, 5-port

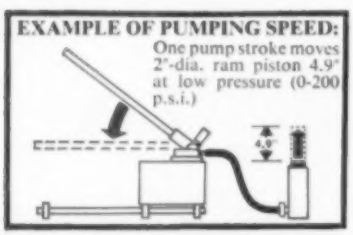
Need to send a cylinder home hard but return it softly . . . or vice versa? This 4-way, 5-port lets you supply two different pressures to the cylinder. And the air index adaptor gives you momentary action. The main valve reverses and stays put with each air impulse delivered to the air operated head.

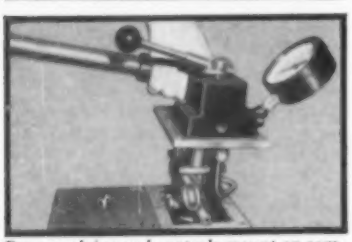
For more information write us, or contact your nearby Ross representative. See our digest catalog in Sweet's

THE WORLD'S MOST COMPLETE LINE OF AIR CONTROL VALVES. AVAILABLE ALL OVER THE FREE WORLD.

Ross OPERATING VALVE COMPANY
105 E. GOLDEN GATE • DETROIT, MICHIGAN

Get fast ram approach, save time with new 2-speed hydraulic pump





Pump, valving and controls mount on common cover plate; use with other reservoirs.

- **Delivers a big 7.35 cu. in. of oil per stroke at low pressure (0 to 200 p.s.i.)**
- **Delivers .294 cu. in./stroke from 200 to 10,000 p.s.i. for high force requirements**
- **For operating both single and double-acting cylinders**

Here is a compact, precision-built 10,000 p.s.i. 2-speed hand pump with the ability to deliver exceptionally high volume at low pressure for fast ram approach and return. Handle high-force requirements, yet waste no time getting the ram to the work! Choice of 2-way or 4-way control valve, mounted easily on cover plate; no exposed piping. Unit weighs only 34 lbs.

Ask your OTC distributor about the new OTC "Dualmaster" pump.

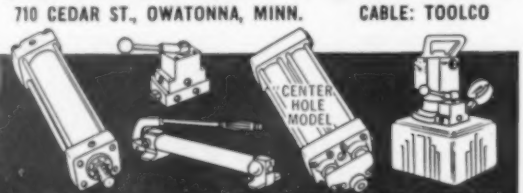
PRECISION HYDRAULICS DIVISION

OWATONNA TOOL CO.

710 CEDAR ST., OWATONNA, MINN. CABLE: TOOLCO

RESEARCH · ENGINEERING · DEVELOPMENT

OTC



DESIGNERS AND MANUFACTURERS OF QUALITY HIGH PRESSURE HYDRAULIC COMPONENTS

Circle **123** on Reader Service Card

LETTERS to the editor

Address your letters to: The Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Component symbols

TO THE EDITOR:

In the article "Directional Control Valves" in the February '61 issue, there are simplified diagrams of hydraulic directional control valves. Please let me know if this type of illustration is available for other hydraulic components.

I have found that the symbols for the various hydraulic components are confusing except to those who specialize in this field. Conducting a small survey, I found that the average user of hydraulic components did not understand the symbols. Technical literature using the symbols for illustration found its way into the waste basket unread. This is the first time I have seen the symbols clearly explained.

T. POBUK
Supervisor-Special Equipment
Clock & Timer Dept.
General Electric Co.
Ashland, Mass.

The chart you have referred to combines pictorial valve diagrams with corresponding ASA symbols to explain valve porting. Succeeding articles in this series have included similar charts for pressure control valves and flow control valves. Similar basic diagrams for other hydraulic and pneumatic components are given in the FLUID POWER HANDBOOK & DIRECTORY *to be published in November.*

Piping Handbook

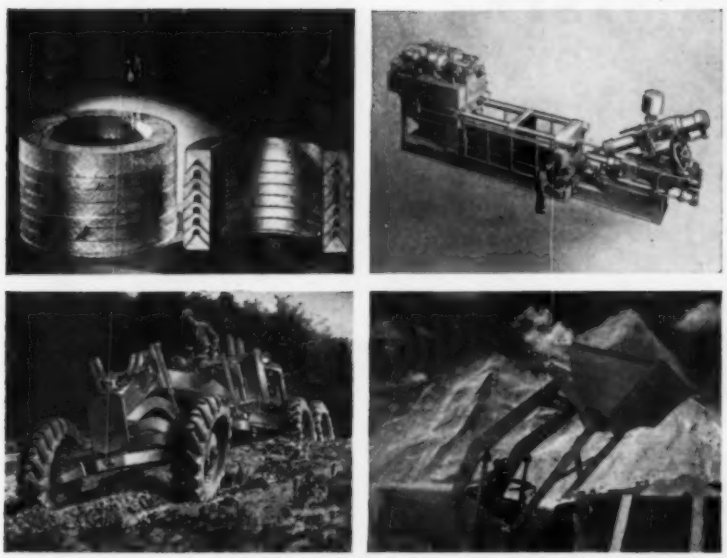
TO THE EDITOR:

The Hawaiian sugar industry builds many agricultural field machines using oil hydraulics. One of our major causes of hydraulic failure has been the contamination of the working fluid by welding slag, filings, and other foreign material. We feel this is

Continued on page 14

ENGINEERED PACKINGS

for Hydraulic, Pneumatic Service



Wherever fluid power is used, Garlock CHEVRON* Packings (upper left) stop leakage, increase efficiency . . . on heavy industrial apparatus like this plastics injection molding machine (upper right), construction equipment such as road graders (lower left) and tractor shovels (lower right).

Design to include Garlock CHEVRON Packings on your hydraulic-pneumatic application. Others have, and are enjoying a longer lasting, more positive seal than ever before.

At all pressures, CHEVRON Packings provide low-friction, leak-proof operation. Designers find them ideally suited for use on single and double-acting hydraulic cylinders, hydraulic rams, plungers of pumps and other reciprocating rods.

Flexible and sensitive to pressure change. Garlock CHEVRON Packings employ an exclusive hinge-like construction. When the pressure is on, the packings tighten to prevent leakage. When the pressure declines, the packings maintain a tight seal but ease off to allow the rod or ram to return without binding. CHEVRON Packing Rings provide adequate heel clearance for easy installation. Once installed, further gland adjustment is rarely, if ever, necessary to compensate for pressure changes. Garlock CHEVRON Packings work very efficiently in shallow stuffing boxes. Apply them against water, steam, oil, gases and chemicals in temperatures to +600°F.

For hydraulic-pneumatic service of all types, Garlock offers a complete line of products. *Garlock "O" Rings* for static and dynamic applications . . . *Garlock* CHEVRON *Rings* for rod and stuffing box seals on reciprocating applications . . . *Garlock Cup Packings* for hydraulic-pneumatic, low friction service.

Find out more about the many materials and sizes of Garlock Hydraulic-Pneumatic Packings. Call your Garlock representative at the nearest of the 26 Garlock sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-115 (CHEVRON Packings), AD-148 ("O" Rings), and AD-189 (Cups). Garlock Inc., Palmyra, New York.

GARLOCK

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Co.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*REGISTERED TRADEMARK

HYDRAULIC WATCHDOG

POSITIVE AUTOMATIC PRESSURE CONTROL FOR ANY HYDRAULIC SYSTEM

FULFLO

ALERT... instant pressure regulation gives complete protection
FAITHFUL... engineered for long, trouble-free service
QUIET... shear-closing action eliminates "chattering"

FULFLO

Whatever your requirement . . . for O.E.M. use or replacement service, there's a dependable FULFLO Oil By-Pass Relief Valve designed just right, built right and priced right too!

STANDARD MODELS

Screw or flange types—to 500 lbs.—for pipe sizes to 3"—steel, cast iron or brass bodies—brass, steel or stainless trim.

SPECIALS

Engineered to your most exacting requirements, for any application, designed to do your particular job to perfection.

Write for Data Book with complete specification and engineering data.

THE FULFLO SPECIALTIES COMPANY, INC. • 415 Fancy Avenue • Blanchester, Ohio

Circle 59 on Reader Service Card

LETTERS

caused by the unclean working conditions common to most job and farm shops which do not ordinarily build precision equipment. We would therefore like to set up specifications to aid in proper fabrication and assembly. These would include procedures for cleaning and assembling piping and reservoirs. Has your company published information which would aid us in our work?

W. E. HART
Research Engineer
Field Engineering Department
Hawaiian Sugar Planters Assoc.
Honolulu, Hawaii

In the May '57 issue we published two articles which should be helpful, "Installing Fluid Power Lines" and "Port Seals . . . What's Available, What They Can Do." An excellent booklet on hydraulic piping is available from Parker-Hannifin Corp. It is titled, "Tube Fitter's Manual."

Fluid power training

TO THE EDITOR:

We are in the school technical training field. We are vitally concerned with the hydraulics and pneumatics field, under both the science in the industrial arts vocational areas.

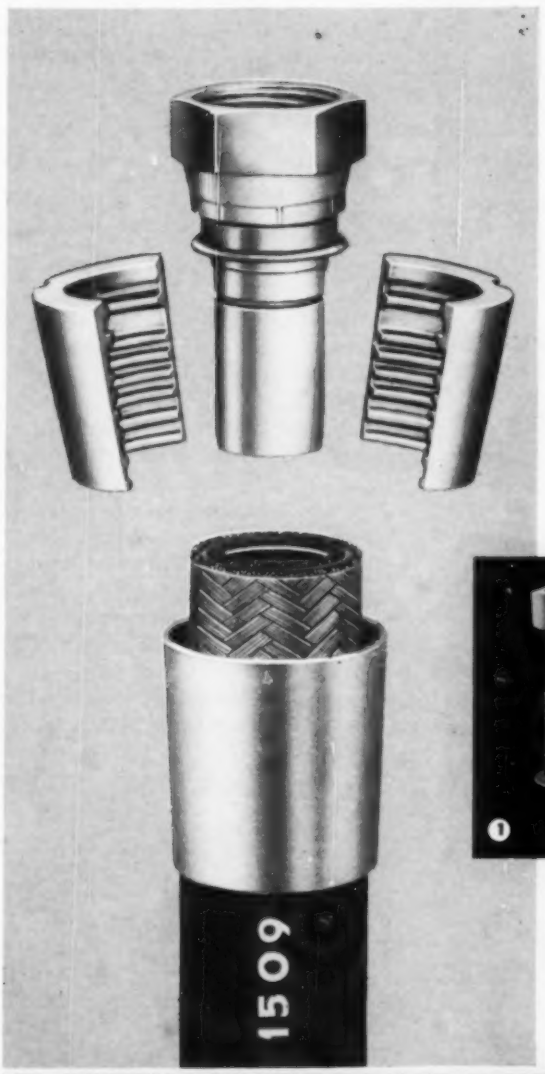
Please send us information about:

Manufacturers' supply sources for basic hydraulic and pneumatic components,
Technical information and design suggestions for these areas,
Training models,
Repair manual sources,
Training school curricular outlines.

E. J. KONOPKA
Senior Educational Consultant
Howard & Smith, Inc.
Detroit

We suggest you contact the National Fluid Power Association for this information. Also, the FLUID POWER DIRECTORY *gives information on the manufacturers' supply sources, technical information and design suggestions which you mention.* ▼▼▼

NEW IRON MIKE T.M.



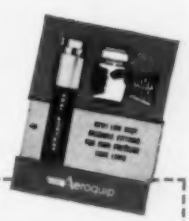
REUSABILITY PLUS LOW COST MAKE IT THE MOST IMPORTANT NEW HIGH PRESSURE HOSE FITTING IN YEARS

Aeroquip scores a major breakthrough in the cost of high pressure hose lines. IRON MIKE Fittings are completely reusable! IRON MIKE Fittings are exceptionally low cost! They give you the design, prototype, manufacturing and field service advantages provided by hose lines with standard reusable fittings . . . at the low cost of hose lines with non-reusable fittings.

Use IRON MIKE Fittings with Aeroquip Multiple Wire Braid Hose for hydraulic systems up to 2250 psi. as well as for pneumatic, fuel and lubrication lines. IRON MIKE Fittings are available with 10 standard end styles for hose sizes from ¾" to 2" I.D.

Field tested and thoroughly dependable, IRON MIKE Fittings feature quick, easy, foolproof assembly. Get complete information by returning the coupon below.

IRON MIKE Fittings consist of a steel nipple, two aluminum segments, and a tapered steel socket. Assembly of IRON MIKE Fittings and 1509 Hose is simple and sure: 1. Rubber Cover is stripped from hose end and threadless nipple is inserted into hose. 2. Two segments mate with nipple assembly to assure correct positioning. 3. Tapered socket is forced over segments to form a rugged compression fitting.



PATENT APPLIED FOR

Aeroquip

AEROQUIP CORPORATION • JACKSON, MICHIGAN
INDUSTRIAL DIVISION
INDUSTRIAL PLANTS: VAN WERT, OHIO; BURBANK, CALIFORNIA; DALLAS, TEXAS; PORTLAND, OREGON; PATERSON, NEW JERSEY
In Canada: Aeroquip (Canada) Ltd., Toronto 19, Ontario
In Germany: Aeroquip G.m.b.H., Baden Baden-Oos

Aeroquip Corporation, Jackson, Michigan

Please send me Bulletin 651 on new IRON MIKE Fittings. HP-7

Name _____

Title _____

Company _____

Address _____

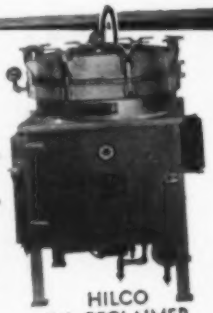
City _____ Zone _____ State _____

Keep YOUR HYDRAULIC SYSTEM Clean with HILCO HYDRAULIC OIL FILTERS

- No More Varnish and Sludge Deposits
- No More Flushing and Manual Cleaning
- No More Frequent Oil Changes
- No More Accumulation of Dirt

Filter life up to a year eliminates usual frequent draining, refilling of systems.

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.



HILCO
OIL RECLAIMER

For complete oil reclaiming. Removes solids, acids and volatile impurities; moisture, solvents, gasses, etc., from hydraulic fluids by heat-vacuum process.

• SEE FOR YOURSELF HOW HILCO keeps your Hydraulic System Clean . .

WRITE TODAY FOR THIS *Free* BOOKLET

Recommendations at no Obligation

THE HILLIARD *Corporation*

148 W. FOURTH ST. • ELMIRA, NEW YORK

IN CANADA: UPTON-BRADEEN-JAMES, LTD. 890 YONGE ST. TORONTO • 8760 VERVILLE ST. MONTREAL

Circle **83** on Reader Service Card

FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

• What improvements would you like to see in fluid power components?

One-Shot Pumps

Variable volume pumps are helping to overcome the need for heat exchangers. The only stumbling block has been their cost. More economical, variable volume pumps with delivery practically full before deadheading are needed.

In machines where hydraulics are used primarily for operating the automatic loading components there is a growing need for a system whose pump does not operate continuously. Instead a series of cam-operated pistons driven by an electric motor could supply individual cylinders with a shot of oil in proper sequence to manipulate the loading device. This could simplify the hydraulic system tremendously.

W. H. PICKENER
Hydraulics Engineer
Fellows Gear Shaper Co.
Springfield, Vermont

Future for Hydraulics

There is a demand for increased speeds and loading on mobile equipment using hydraulics for its main power transmission media. This has created a need for higher working pressures and higher efficiencies. These limiting factors are determining the feasibility of continuing with hydraulics in larger equipment. These larger capacity units need larger components and larger transmission lines which result in lower

Continued on page 18

Now... PROMPT DELIVERY from Modernair® Trademark

SERIES **TA** *and* **TH**

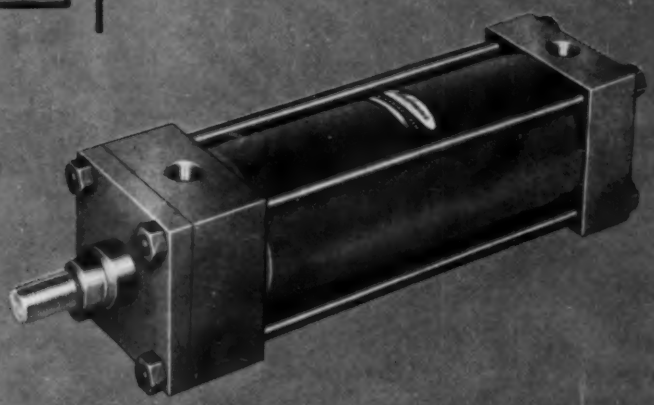
HEAVY DUTY CYLINDERS

SERIES TA — for air service to 200 psi

SERIES TH — for hydraulic service to 2500 psi

Modernair's TA series is specifically designed to meet the need for a rugged, reliable low pressure (200 psi) air cylinder with exceptionally long service life under heavy mill-type operating conditions.

TH series cylinders are designed for heavy duty hydraulic service at pressures from 500 to 2500 psi.



FEATURES

* Meet or exceed applicable JIC standards.
* Piston rods of heat-treated alloy steel, chrome plated and polished, with wrench flats.
* Lip-type piston packing; synthetic wear-compensating rod wipers; boots available.
* Series TA heads of aluminum alloy; TH heads machined from cold-rolled steel.
* Series TA barrels of seamless brass tubing ⅛" wall thickness; Series TH barrels are honed steel.
* Available in 1½", 2", 2½", 3¼", 4", 5" and 6" bore sizes, all popular mountings.

TH Series Operating Pressures

Bore Size	PSI Hydraulic Operating Pressure		
	Heavy Duty Service	Non Shock Service	4:1 Safety Factor
1½	1500	2500	1500
2	1500	2500	900
2½	1000	1500	500
3¼	1500	2500	950
4	1000	1500	600
5	800	1200	450
6	800	1200	500

Whenever you have a tough application where reliability, long service life and minimum down-time for maintenance are vital factors, it will pay you to investigate Modernair TA and TH Series Heavy Duty Cylinders. See your phone book yellow pages for your local Modernair distributor, or write us **now** for complete specifications, dimensions and prices.

Modernair® Trademark **CORPORATION**

400 Preda Street • SAN LEANDRO, CALIFORNIA • Phone: LOckhaven 2-6485

5007 Brookpark Road • CLEVELAND 34, OHIO • Phone: SHadyside 9-6393

Copyright 1961 Modernair Corporation

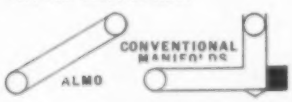
MEMBER NATIONAL FLUID POWER ASSOCIATION — 51

LET'S TALK MANIFOLD FACTS!

The advantages of (Almo) manifolds as opposed to other manifolds are many. Their unique design offers complete flexibility in the mounting of take-offs and valves. Thus an Almo manifold is more adaptable to your requirements. Here are 3 features that definitely effect performance, weight and size.

ALMO* HYDRAULIC MANIFOLDS

1. Flow lines are short as possible with no corners or sharp recesses to collect dirt and obstruct flow.



2. Method of construction permits better utilization of area, smaller overall dimensions and fewer complications while maintaining correct channel dimensions and constant operating pressures. PSI capacity is a built-in quality.

3. Rectangular cross section of flow lines makes possible thinner overall construction and less weight than in comparable manifolds.

WEIGH THESE FACTS!

Let us work with you in improving your product. Write for brochure.

ENGINEERING RECOMMENDATIONS

"THE UNIQUE FLUID CIRCUIT"

ALMO MANIFOLD & TOOL CO.

11472 KALTZ / CENTERLINE, MICH.

Circle 7 on Reader Service Card

FORUM

over-all efficiencies. But, if higher pressure, standard components would be developed, a definite design advantage on larger equipment would be gained. A comparison to direct power transmission must be made. An advantage cannot be gained over shaft and gear drive until efficiencies of 90%-plus in hydraulic power transmissions coupled with pressures to 10,000 psi are on the market for large mobile equipment. However, because of the increasing demand for hydraulics, and its unsurpassed flexibility, its position as a leader in power transmission systems will keep improving, and efficiency and pressure problems will be solved.

JAMES G. MORROW
Design Engineer
Travelift Div.
Drott Mfg. Co.
Sturgeon Bay, Wis.

Larger Flow Controls

We need flow control valves larger than any presently made. It is desirable to have these with capacities to 50 or 60 gpm for hydraulic oil. These larger flow control valves would eliminate "ganging" the smaller units.

A. S. MCINTIRE
Engineer
Corps of Engineers
Portland, Oregon

Standards Meet Needs

All of the hydraulic equipment we use is either built into or used in conjunction with production machinery in our plant. We do not use any hydraulic equipment in products we manufacture. All of our current needs can be met satisfactorily with equipment available from present sources.

L. A. STAPLETON
Chief Engineer
Scripto Incorporated
Atlanta, Georgia

Slower Motors

I have noted that some manufacturers are going to higher power, slower speed motors. I believe there is a need for this and also for suitable controls—especially on multi-motor installations where synchronizing is required.

T. GEST
Plant Engineer
Republic Steel Corp.
Cleveland, Ohio

4000-rpm Pumps for GSE

The pumps and motors that I use for ground support equipment are limited by requirements of reliability, compactness, lightweight, and suitability for use under extreme environmental conditions. The size and weight of existing units should be reduced by increasing the operating speeds. Pumps to operate at speeds of 2800 rpm to 4000 rpm with gasoline engine drives and 3600 rpm with electric motor drives would permit the use of direct connected drives and eliminate the need for speed reducers.

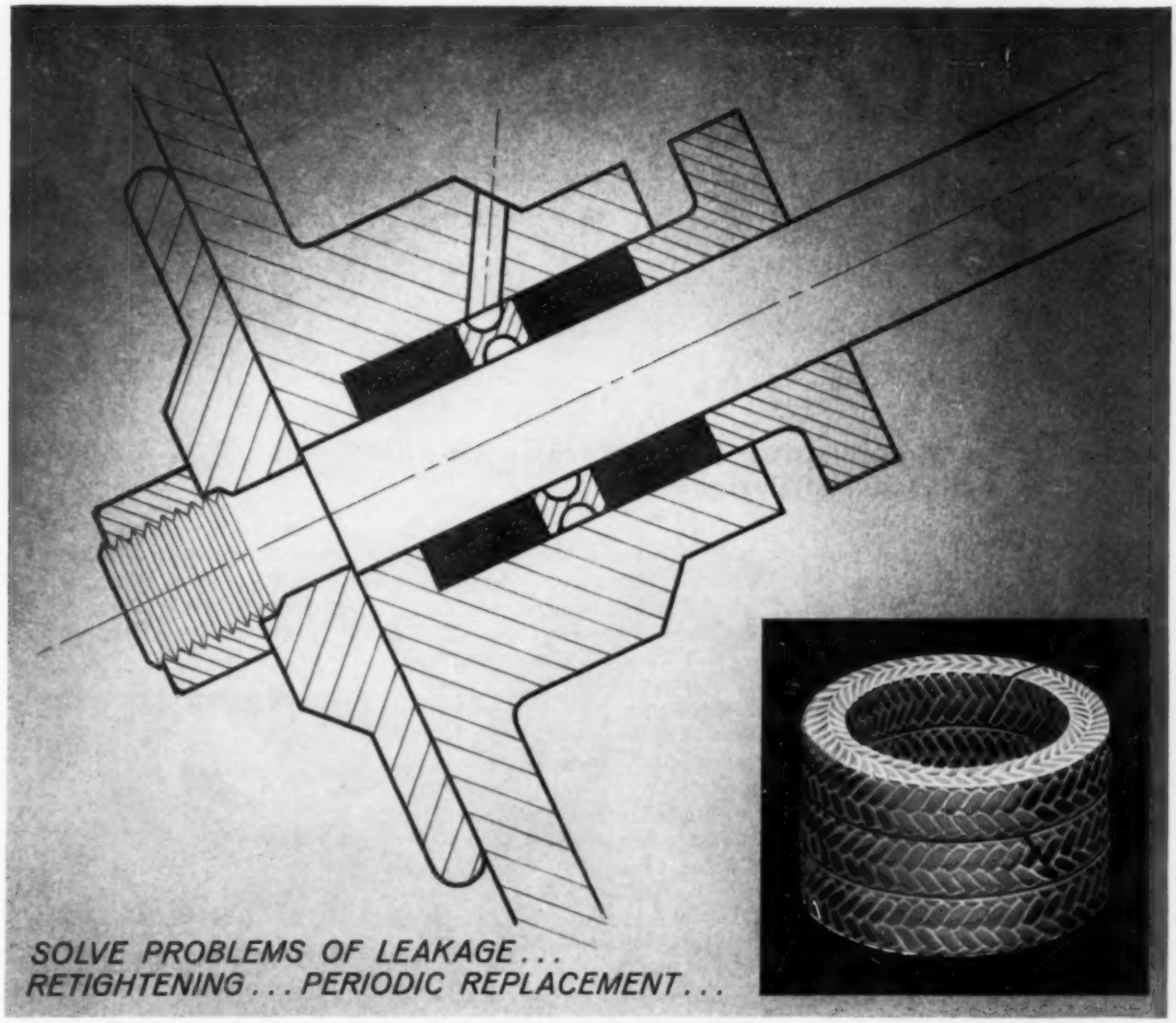
Use of aluminum alloy housings and stainless steel internals, where possible, and Teflon seals would make existing units more universal. Then they could be used with the various fluids used in ground support equipment, especially in the temperature range of −65 F to 250 F.

The pressure rating range of 2000 psi for gear pumps to 6000 psi for piston pumps and a limited number of 10,000 psi pumps appears adequate for present requirements. However, the selection of equivalent high pressure motors is limited.

Lastly, the component manufacturer would provide a valuable service if certified performance data were provided to design engineers to facilitate the evaluation and selection of a unit to obtain the best application and design of the system.

D. WALTMAN
Chief Project Engineer
Henry Spen & Co., Inc.
Brooklyn, N. Y.

▼▼▼



Specify packing of asbestos and TEFLON® TFE

Packings of asbestos impregnated with Du Pont TEFLON TFE-fluorocarbon resins are designed for virtually all rotating and reciprocating shaft applications . . . for long, trouble-free service in hydraulic and pneumatic compressors, pumps and valves. The impregnation of TEFLON makes a mechanical bond with the asbestos: unlike other additives, it will never squeeze out to leave a dry, abrasive packing. Packing of asbestos and TEFLON TFE is easily installed. Once seated, it does not require periodic retightening. It lasts indefinitely. In many cases it permits unlubricated operation. TEFLON TFE resins are completely unaffected by all types of corrosive hydraulic fluids, and are rated for continuous operation from –450°F. to 500°F

It will pay you to specify this maintenance-free packing material for *your* equipment. For more information, write: E. I. du Pont de Nemours & Co. (Inc.), Dept. HP-9, Room 2526T, Nemours Bldg., Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.

DU PONT TEFLON® FLUOROCARBON RESINS

REG. U.S. PAT. OFF.

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

FLUID POWER AT WORK

keeping up with design, application, methods

Hydrostatic Transmission & Gas Turbine Combine in Advanced Tractor Design

Under its sleek exterior, International Harvester Co.'s newest research tractor has a hydrostatic transmission system powered by a turbine engine. The transmission provides infinitely variable speed control, and the engine is capable of delivering horsepower roughly equal to its weight.

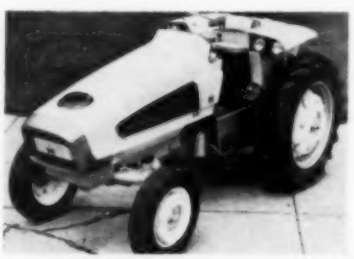
Eliminating gears, shafts, and splines of a conventional transmission, this system uses oil at high pressure to transmit power by acting on the pistons of a radial hydraulic motor installed at each driving wheel.

Actually, there is no rear axle—just a yoke that serves as a structural member and conduit for the transmission's oil lines. The radial hydraulic motors are positioned within the protection of each drive wheel hub and are powered by the variable displacement pump.

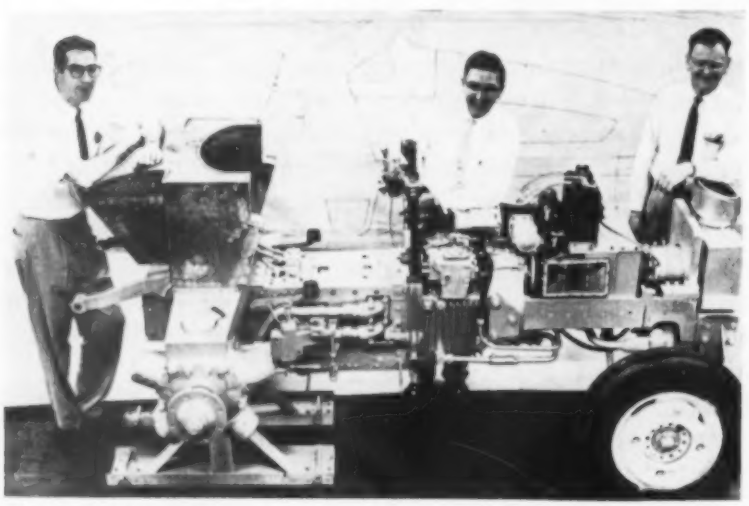
With its constant speed engine, the tractor's throttle lever is gone. Also missing: the conventional gear shift lever and brake and clutch pedals.

• **Single Control**—To start, the operator merely pushes a button. After that (except for steering) he is concerned with just one control—the transmission lever—to change forward and reverse speeds and to stop. The hydrostatic tractor has excellent torque characteristics. Response to its transmission control is immediate and solid throughout its speed range up to 11 mph.

At present the tractor can use only about half the turbine's rated horsepower of 80 hp since the transmission was designed to operate with a 40-hp conventional type piston engine. Gearing reduces speed of the turbine's output to 2000 rpm.



FIBERGLASS SKIN of research tractor shows sleek styling of future tractors.



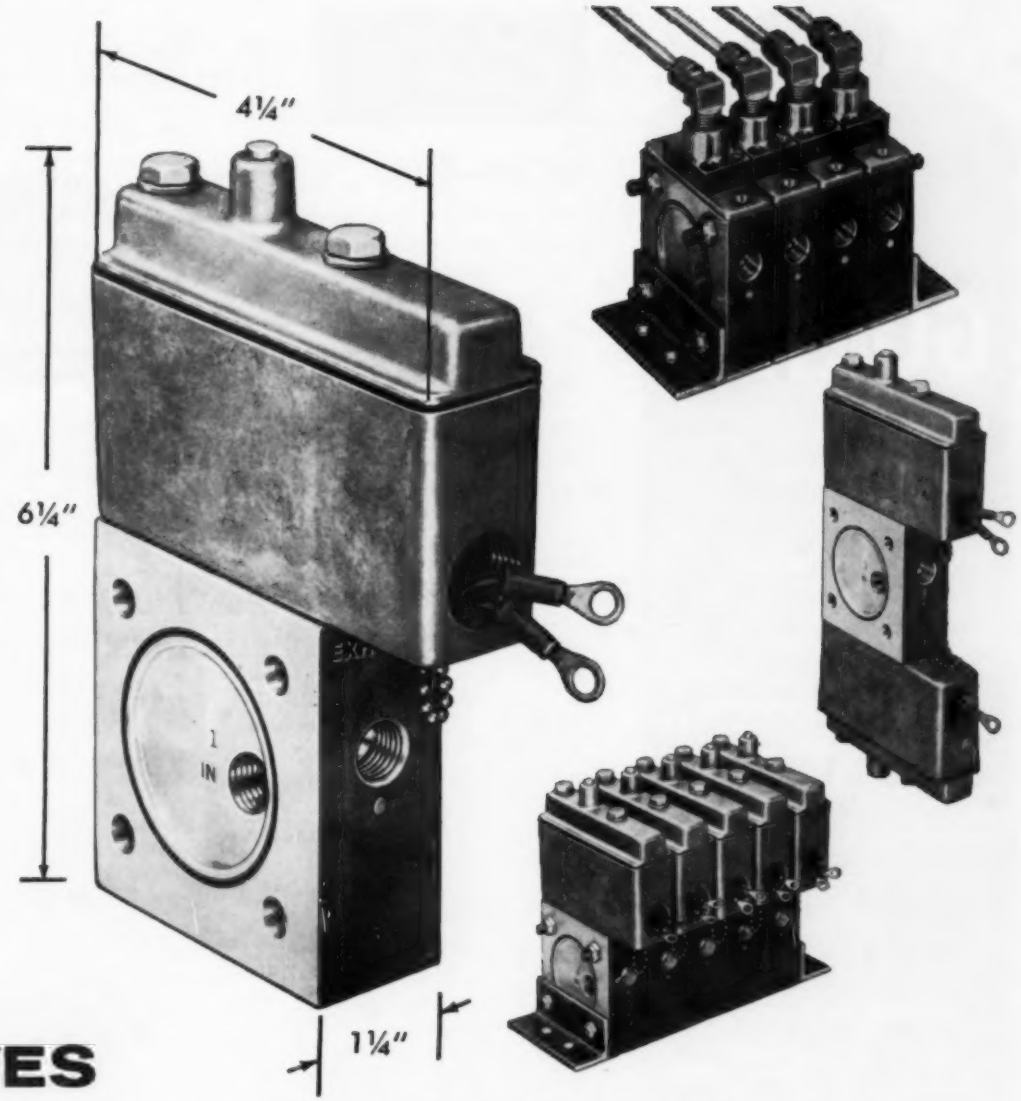
RADIAL PISTON MOTORS are installed at each rear wheel. There is no rear axle—just a structural member. Shown with the tractor are from left, Jonh Cromack, test engineer; Carl H. Meile, chief engineer; and Ralph E. Wallace, research engineer.

Harvester's intent in developing this tractor is to continue investigation of the latest types of power systems. This is one of the combinations that is new and promising.

Despite recent progress, however, fuel economy remains a big question to those interested in using turbines to propel ground vehicles. Also, much research must be completed with heat-resistant materials and precise production methods before the gas turbine can become a competitive, commercial power source for a farm tractor. ▼▼▼

SLIM LINE

VALVES



• minimum space • building block design
• maximum control flexibility

Here's truly miniaturized, versatile precision control with surprisingly large flow capacity . . . Slim Line valves! Mount them singly to control clamping devices on jigs and fixtures. Or, bank them in manifolded groups of as many valves as you need, limited only by service and air requirements. Choose from 3- and 4-way types, for air, oil or water service, pressures to 125 psi, tapped ⅛ or ¼ in. NPT.

Where space is limited and you require maximum precision and versatility to control one or a virtually unlimited number of small or medium size cylinders, diaphragms, pilot cylinders, or similar devices . . . you need Slim Line valves. Ask your nearby Hunt representative for proof.

3048

For more information, write for Bulletin 612. Address Hunt Valve Co., Salem, Ohio, Dept. AH-961.

HUNT

QUICK-AS-WINK© AIR AND HYDRAULIC

VALVES

HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

Circle 86 on Reader Service Card

GORTITE

Pliable protection—
fabricated to order
without molds—
BELLOWS . . . BOOTS . . .
SLEEVES . . .
WAY-PROTECTORS:

All GORTITE, protective parts are fabricated from new, neoprene-base materials, nylon-coated fabrics, fiberglass, Teflon, etc., to meet individual, service conditions: There are materials to withstand temperature extremes from —40° F. to 500° F., without cracking.

GORTITE protective parts are impervious to oil, grease, dust, dirt, sand, chemicals and abrasives. Bulletin AH-3 sent on request to—

A&A MFG. CO. INC.
712 S. 12th St.
Milwaukee 4, Wis.

ALL SHAPES AND CONTOURS—
BELLOWS . . . BOOTS . . . SLEEVES . . . WAY-PROTECTORS
FOR HYD. CYLINDERS, RAMS, JACKS, WAYS, ETC.

Circle 1 on Reader Service Card

FLUID POWER AT WORK

NCIH—1961

"Versatility and Reliability of Fluid Power" will be the theme as technical men gather for the 2-day session of the National Conference on Industrial Hydraulics next month in Chicago. Papers will be presented on a wide range of fluid power subjects covering applications and basic technology of industrial, aerospace, and mobile equipment. Approximately 25 papers will be given, some by panels of users, designers, and maintenance representatives.

• **17th Conference This Year**—Started in 1945 by Armour Research Foundation of Illinois Institute of Technology, and the Graduate School of the Institute, under the name "Conference on Hydraulic Machinery," technical sponsorship of the Conference was later broadened to include engineering societies with an interest in fluid power.

The purpose of the Conference is to fulfill a need for a free interchange of ideas on the problems being confronted in the large and growing field of hydraulics and pneumatics. The program attempts to balance the contributions of technical material from industry and from education and research institutions, and to maintain it on a high technical plane. The Conference hopes to raise the general technical level of knowledge by the contribution of papers and discussions on both the fundamental and the applied phases of industrial hydraulics. It is open to all those with an interest in fluid power.

A program is available from Wm. Smith, Conference Secretary, Illinois Institute of Technology, Chicago 16, Ill.

NFPA News

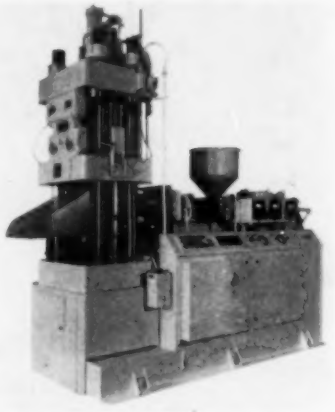
NFPA Adopts Slogan

A new insignia, slogan, and official rules for their use and control were adopted by members of the National Fluid Power Association at their Spring meeting last May. Shown is one of the four insignia-slogan combinations the NFPA plans to use. The slogan "Energy for Industry", and the plain insignia can also be used alone or in combination. Copies of the rules may be obtained by writing to the NFPA, 5595 N. Hollywood Ave., Milwaukee 17, Wisc.

NFPA NATIONAL FLUID POWER ASSOCIATION
ENERGY FOR INDUSTRY

Fluid Motor Drives Injection Molding Press Screw

A 12-ounce capacity automatic injection molding press manufactured by F. J. Stokes Corp., Philadelphia, incorporates a screw plasticator with a unique drive-mechanism design. A shaft connects the screw in the plasticizing cylinder with the piston in the ram cylinder located above it on the same axis. The piston and shaft rotate within the ram cylinder as the screw rotates in the plasticizing cylinder. A hydraulic motor mounted directly above the shaft drives the screw through a stationary, right-angle gearbox.



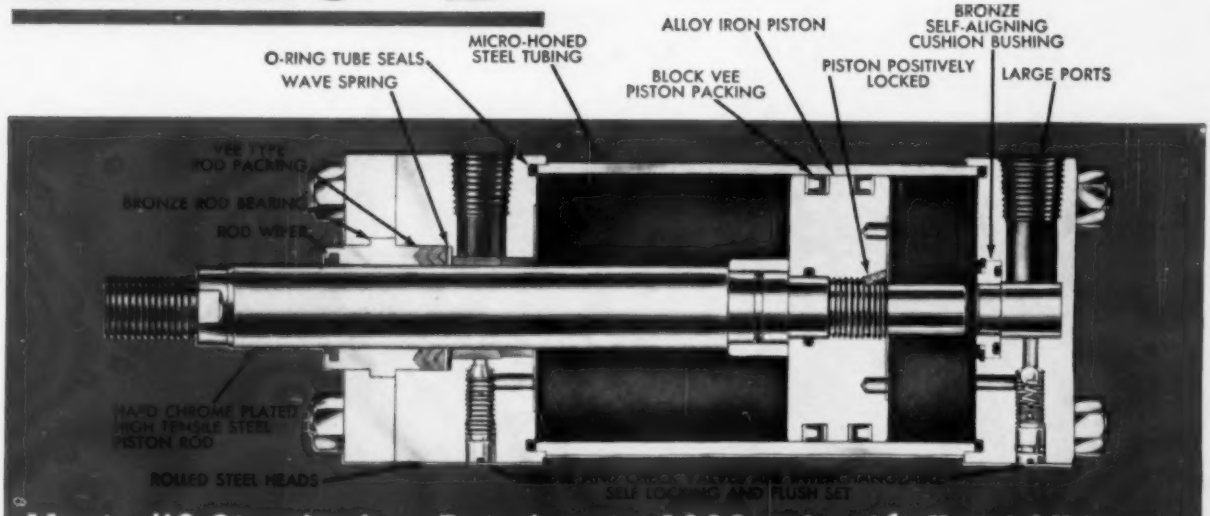
INJECTION MOLDING PRESS has an injection pressure of 20,600 psi and a stroke of 5 in. Maximum clamping pressure is 300 tons.

Continued on page 27

NEW O-M SQUARE HEAD HYDRAULIC CYLINDER

now available

SERIES "L"



Meets JIC Standards • Rated up to 2000 psi • 1½" to 14" Bores

For years, you have looked to Ortman-Miller for the original space-saving, tie-rodless air and hydraulic cylinders. Now, with the introduction of the new Series "K" air cylinder, recently announced, and the new Series "L", hydraulic cylinder, featured above, you can look to O-M for all of your cylinder requirements.

A product of the teamwork of O-M specialists, this new Series "L" hydraulic unit reflects the research, design, engineering and production capabilities and experience that are an integral part of every O-M cylinder. The result, a quality, hydraulic cylinder designed for long service, high operational efficiency and quick, easy maintenance, dimensionally interchangeable with most cylinders of a like type.

For complete details mail coupon today for Bulletin No. 116 in which all cylinders have been dimensioned in accordance with NFPA recommendations for your convenience.

ORTMAN-MILLER MACHINE COMPANY
1143rd Street, Hammond, Indiana

☐ Have representative call

Send Bulletins

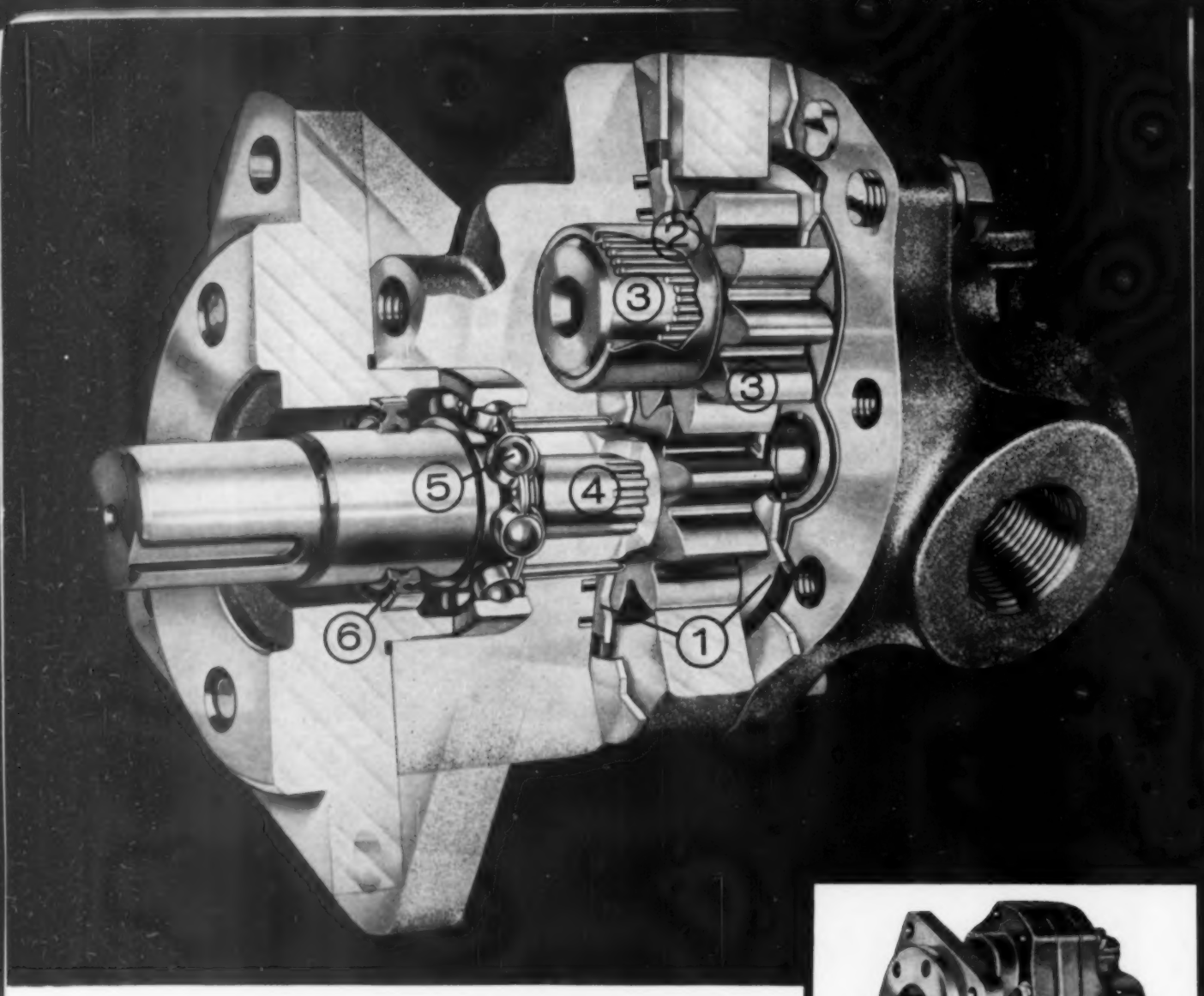
☐ 115 -Series "K" ☐ 116—Series "L"

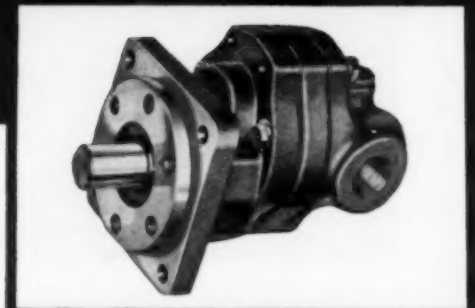
NAME_____ POSITION_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____





Here's how **WEBSTER** *puts new efficiency in hydraulic power*

We cut this new JE series pump in half to show you why Webster design tops competition in overall efficiency. Specifically, the JE saves horsepower, slashes operating costs, delivers dependable and trouble-free service.

It's the result of this combination of advanced features.... (1) pressure-balanced wear plates for high volumetric efficiency and to prevent clearance changes due to heat; (2) needle bearings for power-saving, anti-friction operation; (3) one piece gear and bearing journal units to assure minimum deflection and proper alignment on both drive and idler assembly; (4) free-floating internal spline drives to eliminate key failures; (5) thrust bearing on drive shaft to absorb compound driving thrusts; (6) double lip seal on drive shaft for added protection against seal failure and dirt.

The Webster JE series pump is a heavy-duty, big power unit built to meet the needs of the mobile industry. It is trim and compact to fit into tight quarters, attaches with a choice of mountings. Your Webster Electric representative has complete specifications and data — or write direct for engineering detailed sheet HY1-1.

JE SERIES PUMPS

Shaft seal: double lip type
Drive: direct, gear or belt
Capacity: 10 sizes — 5 to 40 gpm
Pressures: to 2000 psi
Operating Speeds: to 2400 rpm
Porting: side (std.) end (opt.)
Mounting: SAE Type A (std.)

OIL HYDRAULICS DIVISION
WEBSTER ELECTRIC
RACINE · WIS

Norgren Lubricators end uncertainty of "blindfold" lubrication of air tools

Over-lubrication of air tools causes oily, dirty tools and hands. Under-lubrication means costly excessive wear. To get lubrication that is just exactly right requires something better than trial and error, "blindfolded" methods of lubricator adjustment. That is why all Norgren Lubricators have visible oil feed.

Visual adjustment results in positive lubrication Norgren Oil-Fog and Micro-Fog Lubricators have sight-feed glasses which provide full visiblity of oil flow. You can tell at a glance that oil is actually being metered into the air stream.

The exact rate of oil feed is shown by the drops of oil passing through the sight-feed glass. The rate of oil feed can be easily and accurately adjusted. Contrast this with the disassembly and trial-and-error guesswork adjustment required with wick-type lubricators!

The Norgren Oil-Fog Lubricator has proved itself in hundreds of thousands of installations throughout the world for over 30 years. Today, it is still the best low-cost, positive-action lubricator on the market.

The Norgren Micro-Fog Lubricator offers many additional advantages: More exact metering of oil feed; operation over a wider range of air flows; a finely divided fog of oil with little or no precipitation along the air-line; adaptation to multi-tool, or multi-cylinder lubrication.

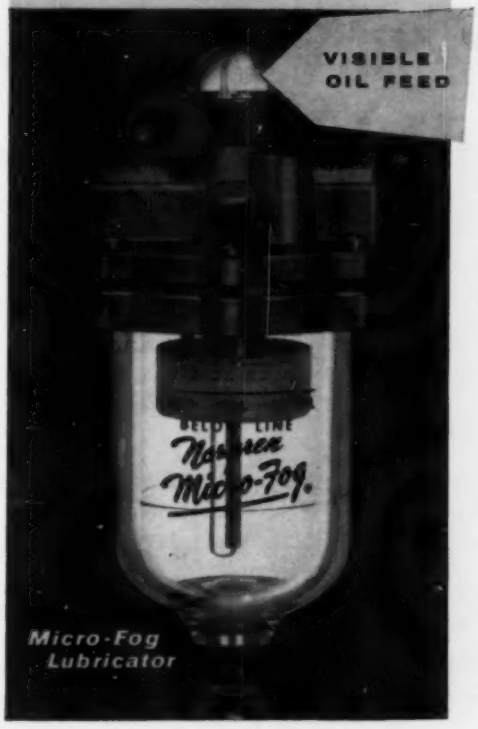
Your Norgren Representative will advise you on your application and will give you complete information about Norgren Lubricators. Look him up in your telephone directory—or write factory for Catalog No. 1000.

FOUNDED IN 1925

C. A. NORGREN CO.

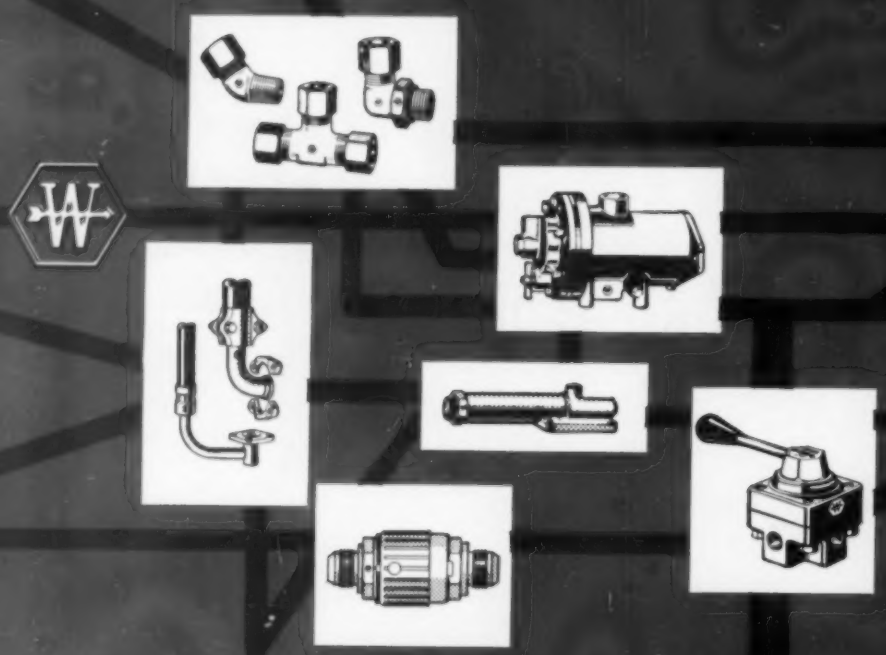
3402 SOUTH ELATI STREET, ENGLEWOOD, COLORADO

Oil-Fog Lubricator



Micro-Fog Lubricator

WEATHERHEAD FLUID POWER PRODUCTS... SYSTEM ENGINEERED



WEATHERHEAD ERMETO

"THE ONLY FITTING WE'VE FOUND THAT ELIMINATES TROUBLE"

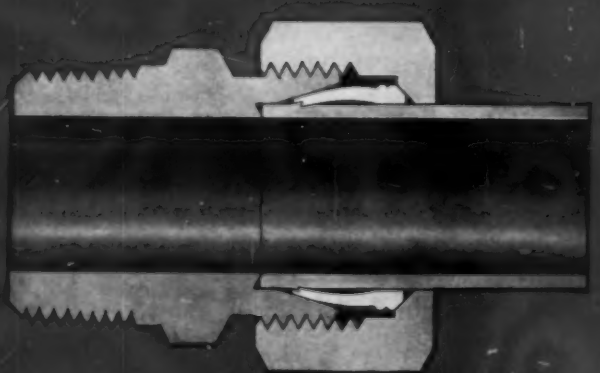
This is typical of reports from users of these self-sealing, high-pressure flareless connectors. Reasons: ease of assembly and disassembly; no special tooling required; avoids threading and flaring while providing positive seal; reusable—maintaining no-leak, stress-free support of tubing after multiple make and breaks.

Weatherhead Ermeto fittings are engineered to withstand severe vibration, shock, pulsating loads, temperature extremes, and pressures to 15,000 psi.

For your fluid system reliability, specify Weatherhead Ermeto.

A complete range from ¼" to 2" is available from your nearby Weatherhead distributor.

THE WEATHERHEAD COMPANY
CLEVELAND 8, OHIO

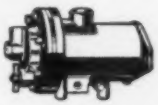


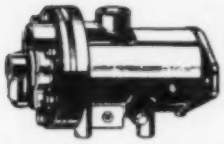
ERMETO®
"Hermetically sealed"

Circle 170 on Reader Service Card

WEATHERHEAD
HYDRAULIC POWER
Components

VARIABLE DISPLACEMENT PUMPS

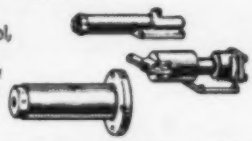




Meet J.I.C., S.A.E., and M.S. standards. Pressures to 3000 psi

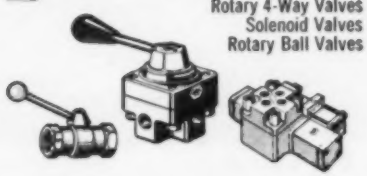
PUMP CONTROLS

Pressure Control, Automatic (Constant) Flow Control, Manual Displacement Control



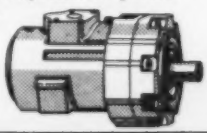
DIRECTIONAL CONTROLS

Rotary 4-Way Valves
Solenoid Valves
Rotary Ball Valves



HYDRAULIC DRIVES

Fixed Displacement Hydraulic Motors, Reversible Variable Displacement Hydraulic Motors (Integrated Torque and Speed Control)



HIGH PRESSURE HOSE AND FITTINGS

Swaged, Crimped, and Field-Attachable Flexible Hose Ends.
Flared and Flareless Tube (Pipe) Fittings.
Integral Check Valves

SELF-SEALING COUPLINGS

Ball Check Valve Type
Full-Flow Rotary Ball Type

THE WEATHERHEAD CO.
300 EAST 131 ST. • CLEVELAND 8, OHIO
Distributors in all major markets
Circle **171** on Reader Service Card

FLUID POWER AT WORK

Continued from page 22

The driving gear engages the screw shaft with gibs and splines which let the shaft move axially back and forth as the screw retracts or advances within the plasticizing cylinder. The hydraulic motor provides infinitely variable speed control and protects against torque overload.

Hydraulic Motor Drives Concrete Mixer Drum

A five-cylinder, radial piston motor powers the drum on this concrete mixer. The low speed, high torque motor, manufactured by Chamberlain Industries Ltd., London, drives the ring gear on the drum base through a 3 : 1 gear reduction. A crankshaft-driven hydraulic pump and booster pump supply the hydraulic system.

HYDRAULIC CONTROLS for the concrete mixer are in cab with a duplicate set at rear of machine.

The machine has a closed hydraulic system. The axial piston pump has infinitely variable displacement in both directions.

SAE Announces Milwaukee Sessions

The Society of Automotive Engineers has announced its activities for the Heavy Duty Vehicle Meeting and Engineering Display to be held at the Milwaukee Auditorium September 11-14, 1961. This will cover five areas: farm, construction and industrial machinery; power plant; transportation and maintenance; truck and bus; and production.

• **Mobile Equipment Hydraulic Systems**—Papers of fluid power interest to be presented at the technical sessions are:

• *Development of a Hydraulically Shifted Transmission*, L. E. Elfes, North America Massey-Ferguson Ltd.

• *A 4-wheel Drive Tractor for Large Farms*, W. J. Askins, Frank G. Hough Co.

• *Powershift Transmission for Earthmoving Equipment*, G. W. Eger, Caterpillar Tractor Co.

• *The High Pressure Hydropneumatic Suspension of the Universal Engineer Crawler Tractor*, R. K. Reynolds and E. Mayer, International Harvester Co.

• *Full Fluid Steering Controls*, D. F. Morgan, Char-Lynn Co.

• *A New Power Steering System for Tractors*, E. H. Fletcher, John Deere Research & Mfg. Center

• *Fork Lift Truck Drives—Straight Stick to Hydrostatic* W. M. Shaffer, Towmotor Corp.

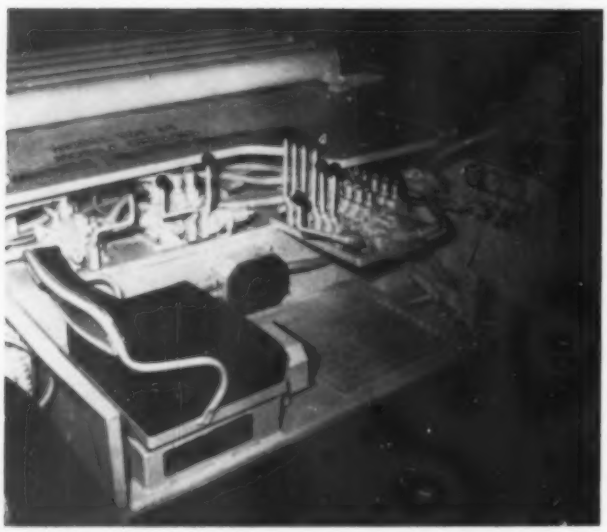
• **Exhibitors at Show**—Manufacturers of hydraulic and pneumatic components exhibiting are:

	Booth No.
Aeroquip Corp.	112, 113
American Bosch Arma Corp.	104, 105
American Sealants Co.	210
American-Standard Controls Div.	102, 103
Anchor Coupling Co., Inc.	156
Bendix Corp.	450, 452, 453
Borg-Warner Corp.	S-1 through S-16
Char-Lynn Co.	204
Commercial Filters Corp.	C-12
Electric Autolite Co.	307-312
Formrite Tube Co.	152
Fram Corp.	164
Hydraulic-Electronic Div. Fawick Corp.	410
Hydraulics Inc.	202
Imperial-Eastman Corp.	456
Perfex Corp.	C-6
Purolator Products, Inc.	106
Raybestos-Manhattan, Inc.	C-5
The Weatherhead Co.	116, 117
Webster Electric Co.	400
Young Radiator Co.	153

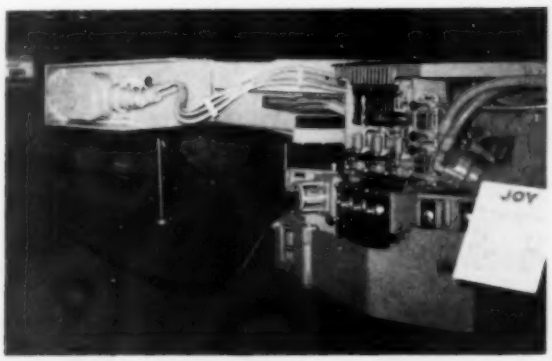
FLUID POWER AT WORK

Fluid Power Helps Dig Coal

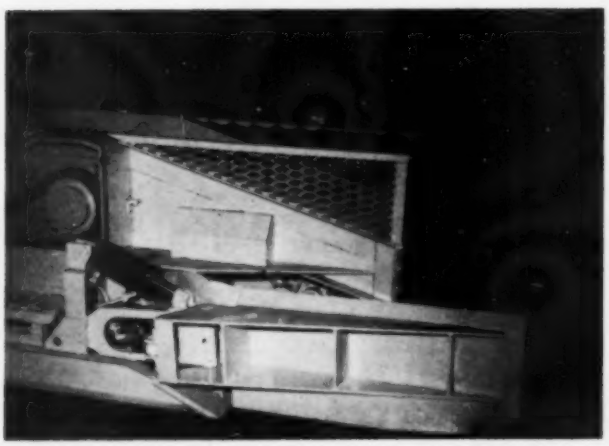
The increasing use of fluid power for coal digging, handling, conveying, loading, and other operations was shown at the annual Coal Show in Cleveland's Public Auditorium.



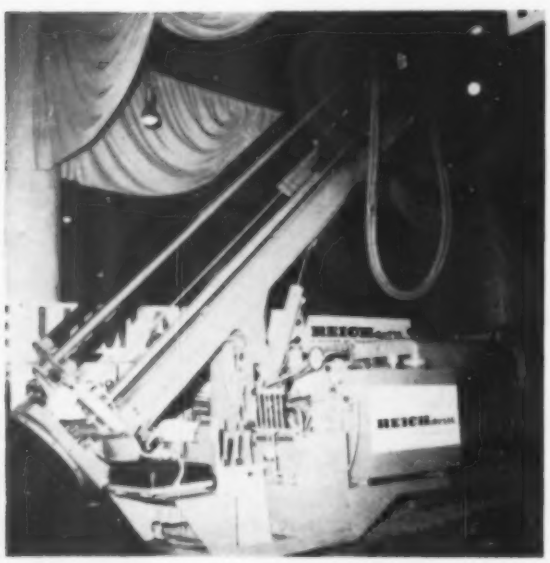
CLOSED CENTER CIRCUIT—Bank of seven control valves at right is connected in a closed circuit on Long-Airdox mobile driller. Machine has one 36-gpm pump to power beam, auger, and arms. A 30-gpm tandem pump supplies fluid for tramming at 0 to 150 fpm, cable rewind, and reel rotation.



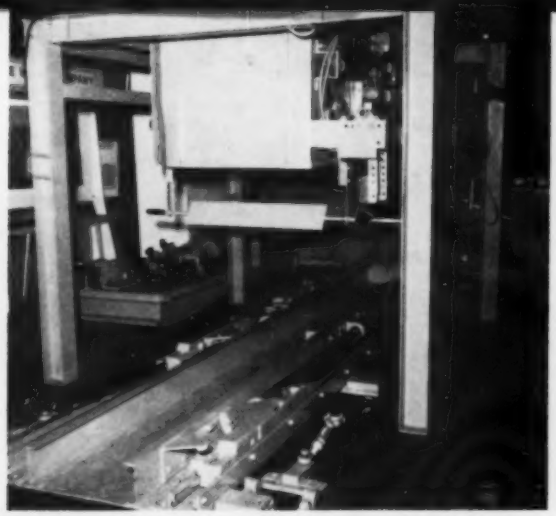
GIANT DIGGER IS HYDRAULIC—Complex control panel of Joy Compton's hydraulic circular miner is shown at rear of machine. Hydraulic motors drive corner chain drive, and disc cutter. Separate 100-hp, a-c motor drives the pump that powers the crawler drive, conveyor drive, and jacks.



MINE TRACK CLEANER—A 6-gpm pump powers 8 cylinders on American Mine Door Co.'s track cleaner. The open-center, 6-section valve controls motions of plow and boom cylinders. Car hitching mechanism is also hydraulic.



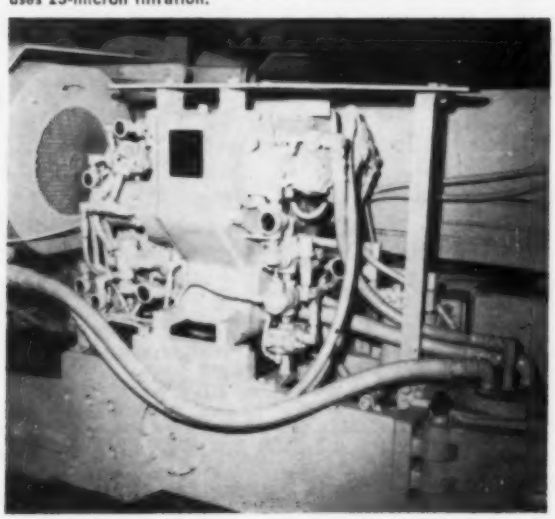
TWO SPEED RIG—Constant volume vane pump on crawler-mounted rig drives dual-speed head which gives two drilling speeds. Reichdrill machine can drill at 65 rpm with 20,000 lb-in. torque, or at 195 rpm at 10,000 lb.-in. torque. Hydraulic power also raises and lowers drilling boom and actuates outrigger jacks.



CAR LOADER IS AUTOMATIC—When a car is filled with coal, a limit switch energizes a valve solenoid actuating a cylinder to close the chute. An empty car then moves up under the Nolan loading station, and is gradually filled from front to rear as it slowly moves under the filling hopper.

AIR PUMPS WALK JACKS—High and low pressure air pumps are used to move these supporting jacks. Mining Progress, Inc. uses single-acting raising jacks. Walking jacks are double-acting and have an 18-in. stroke.

SIGHT FLOW GAUGES USED—Preventive maintenance feature of Goodman Manufacturing machine is the use of sight flow gauges to allow operator to check oil flow visually. Gauges are located in return, relief valve, and leakage lines. System uses 25-micron filtration.



for HEAT and FLUID RESISTANT RUBBER get the GOSHEN RUBBER IDEA*

* to precisely fabricate parts, seals, and components . . . from selected compounds and for specific applications only!

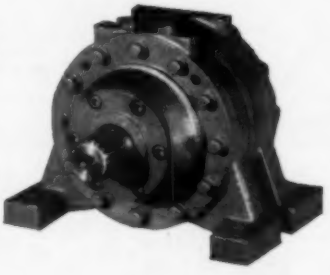
Whatever *your* part's operational environment calls for . . . from Silicone for high and low temperature extremes, to fluorocarbons for solvent resistance, Goshen Rubber has the answer. And, if you have an entirely *new* design requirement, Goshen's laboratory facilities, know-how and experience go to work on your *particular* need. Let us know your problem.

WRITE, WIRE, or PHONE

Goshen RUBBER CO., INC.
1391 S. TENTH STREET GOSHEN, INDIANA
Phone KEystone 3-1111 TWX: GOSH 8701
Circle **67** on Reader Service Card

so then I said to the chief engineer,
"What's a Houdaille HydRoAc?"

We have to admit there are still some people around who have not heard about Houdaille's new complete line of hydraulic rotary actuators. They don't know that Houdaille's HydRoAc has applications unlimited in tooling, roll jigs, fork lift trucks, printing presses, conveyors, turret lathes, indexing devices, drilling machines, sawmill machinery, drive mechanisms, die clamps and many others. So hear this. Houdaille's HydRoAc comes in 4 different sizes—with 20 variations in each size. These units can be foot or end mounted, operated with a variety of fluids or air and have total travel up to 280°. Efficiencies run to 95% or over. Don't be a bum. Send now for the Houdaille HydRoAc catalog.



HOUDAILLE

... Specialists in rotary type hydraulic equipment

Houdaille Industries, Inc.

Buffalo Hydraulics Division • 545 E. Delavan Ave., Buffalo 11, N. Y.

Circle **84** on Reader Service Card

Circle **178** →

New, simplified, low-cost

WOOSTER HYDRAULIC DIRECTIONAL CONTROL VALVE

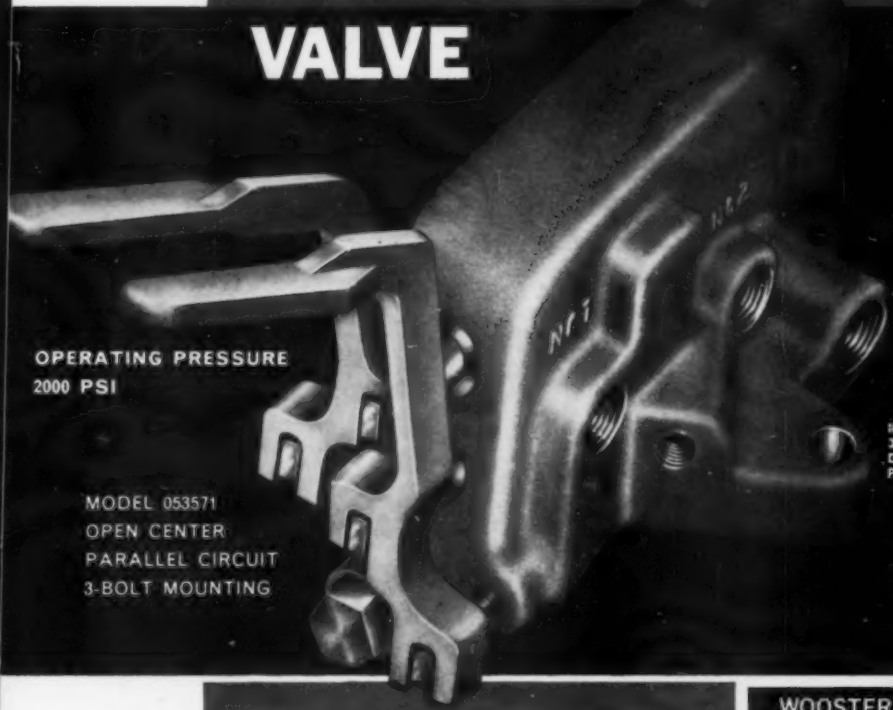
Built for heavy-duty service and long life in agricultural, materials handling, mobile and industrial applications, controlling LIFTING, TILTING, POSITIONING on all types of implements.

FEATURES:

Excellent Metering
Low Pressure Drop
Spring Center Spools
Load Check Valve
Integral Relief Valve
Switch Valve for Spool No. 1
(to externally convert from
4-way to 3-way operation)
SAE or Pipe Thread Ports

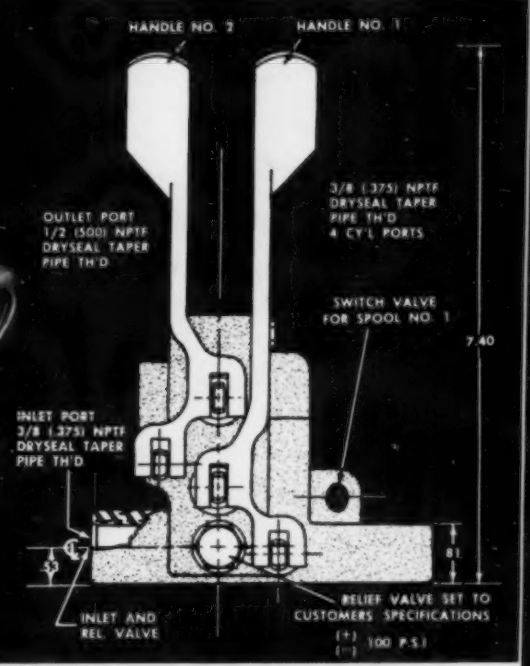
INDUSTRIAL HYDRAULICS

A complete Hydraulic Power Engineering Service



OPERATING PRESSURE
2000 PSI

MODEL 053571
OPEN CENTER
PARALLEL CIRCUIT
3-BOLT MOUNTING



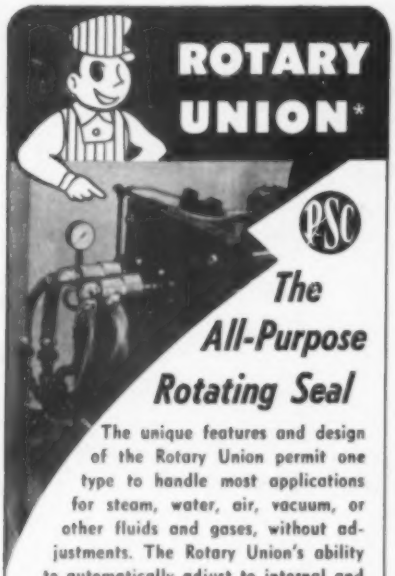
WOOSTER DIVISION

WOOSTER
B-W
DIVISION

BORG-WARNER CORPORATION
WOOSTER, OHIO

EXPORT SALES—Borg-Warner International
36 S. Wabash St., Chicago 3, Ill.

IT'S A BETTER PRODUCT WHEN BORG-WARNER HAS A PART IN IT



ROTARY UNION*

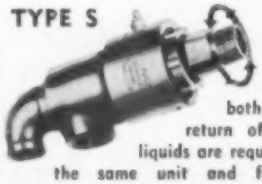
PSC

The All-Purpose Rotating Seal

The unique features and design of the Rotary Union permit one type to handle most applications for steam, water, air, vacuum, or other fluids and gases, without adjustments. The Rotary Union's ability to automatically adjust to internal and external stresses and to variations and surges in line pressure make it the most efficient and long-lasting seal.

There is a Rotary Union for every heating or cooling purpose—through a complete range of pressures, temperatures, and speed. Here are several types.

TYPE S

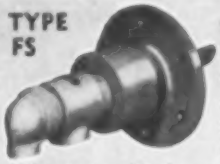


Designed for installations where both supply and return of gases or liquids are required within the same unit and for syphon drainage of coolants or steam condensates, special construction prevents breaking or falling off of syphon pipes. Ball bearing. Pipe sizes ¼" thru 5".

TYPE P

A single inlet unit for conveying gases or liquids into or out of revolving cylinders or drums. Ball bearing. Pipe sizes ¼" thru 5".

TYPE FS



Designed for heavy duty service at high speeds, pressures, and temperatures. The body rotates with the machine journal as part of the machine. Available in both ball bearing and graphite bearing construction and in pipe sizes from 1¼" thru 5". Other types of the Rotary Union are available for a wide range of applications. Ask for bulletin No. 700.

*Trade Name—Patented

"WHERE Good Connections COUNT"®

PERFECTING SERVICE CO.

332 Atando Ave. Charlotte 6, N. C.

Baltimore Buffalo Chicago Cleveland Camden Los Angeles New York Providence Montreal Toronto Canada

Circle 130 on Reader Service Card

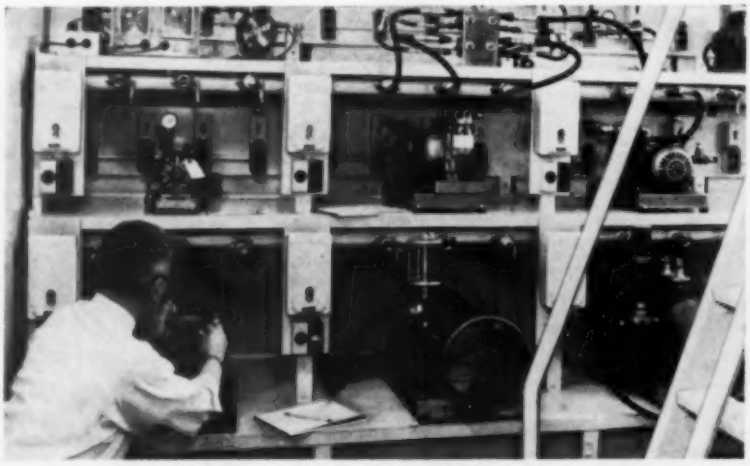
FLUID POWER AT WORK

Modular Plan Used in Gast Lab

A modular plan for pneumatic equipment provides Gast Mfg. Corp. engineers with flexibility and economy in their new laboratory. Design men use the lab to test existing products, to gather data for predicting performance and service life, and to gain knowledge for industrial pneumatics applications.

Several of the instrument consoles can be rolled to various test areas. Controls permit switching modular units or groups of instruments into many combinations for test and development projects.

A compressed air supply is electronically controlled to maintain accuracy to ¼ of 1% in an air pressure range of 100 psi, volume to 1000 cfm. The electrical distribution system has any voltage required. Facilities also include a sound test room and a laboratory office.



ENDURANCE TEST CELLS provide proving ground for maximum of 80 air pumps or motors.

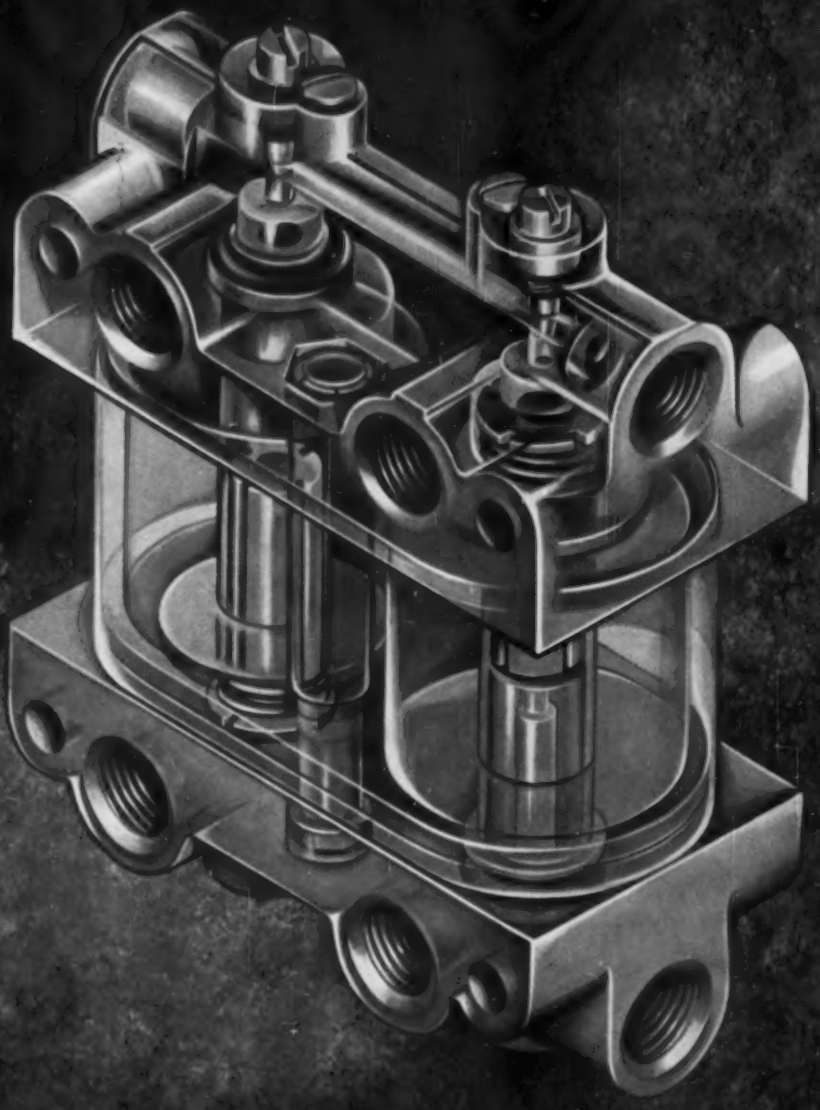
DYNAMOMETERS which are electronically regulated within 1/10 of 1% at speeds to 6000 rpm test air motors, compressors, and vacuum pumps for torque, hp, cfm, and other factors.

Circle 150 →

DIVISION

DIVISION

BORG-WARNER HAS A PART IN IT



Compact 4-way

SKINNER

Solenoid Valves

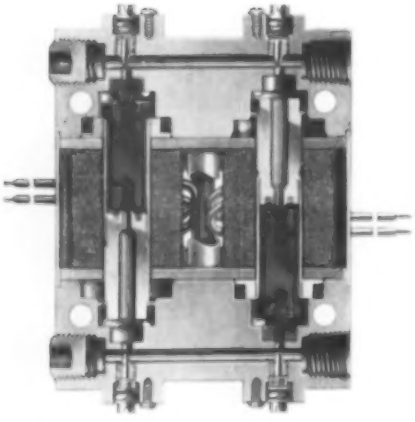
assure precise cylinder control

Here's how accurate, dependable operation is built into SKINNER 4-way solenoid valves

- **Precise flow control**—by adjustable metering
- **Compact, direct acting**—two 3-way valves in one housing
- **Durable and corrosion resistant**—stainless steel internal parts
- **Leakproof, bubbletight sealing**—soft, synthetic inserts
- **Positive operation mounted in any position**—spring-loaded plungers
- **Underwriters approved**—wide selection of coils, voltages and frequencies
- **Wired from front or rear**—housing easily reversed
- **Adaptable to many uses**—optional porting arrangements

A. Transparent view of 4-way solenoid valve B. Plunger
C. Plunger return spring D. Sleeve E. Coil

SKINNER four-way solenoid valves available in three basic types



The Skinner V9 solenoid valve is two 3-way valves in one compact housing. Both valves may be independently controlled and metered to provide accurate, dependable control of single- or double-acting cylinders, or larger pilot-operated valves.

V9 types are available without adjustable flow and with metering at both exhaust ports, both inlet ports or full metering of all ports.

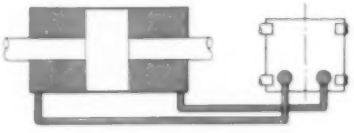
• • •

For complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

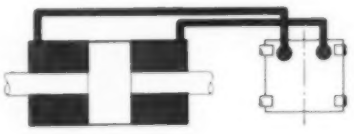
V9 SERIES SPECIFICATIONS

Media—air, hydraulic oils, inert gases
Orifice Diameter—$\frac{3}{64}$", $\frac{1}{16}$", $\frac{3}{32}$", $\frac{1}{8}$"
Pipe Size—$\frac{1}{4}$" NPTF
Maximum Operating Pressure Differential—0 to 150 PSI (up to 225 PSI also available)
Temperature Range—minus 40°F. to plus 180°F.
C_v Factor—$\frac{3}{64}$" .052, $\frac{1}{16}$" .095, $\frac{3}{32}$" .156, $\frac{1}{8}$" .214
Mounting—$\frac{1}{4}$" through-bolt holes.

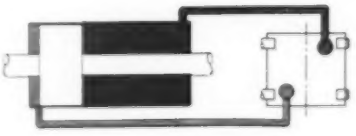
Normally closed—normally closed V933 valves with a neutral position. Generally applied on double-acting cylinders where the piston is in a neutral position without pressure when both coils are de-energized. This permits manual shifting of the piston without operating the valve.



Normally open—normally open V955 valves with a neutral position. Generally applied on double-acting cylinders where both sides of the piston are to be open to pressure when both coils are de-energized. Under certain conditions, the first operating stroke of double-acting cylinders will be smoother with this valve in use.



Normally closed—normally open V935 valves with no neutral position. Generally applied on double-acting cylinders where the piston is to be in retracted or extended position with pressure when both coils are de-energized. Wiring is simple—both coils are operated simultaneously and can be controlled by one single-pole, single-throw switch.



When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed nationally.

THE CREST OF QUALITY

SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIVISION
SKINNER PRECISION INDUSTRIES, INC. • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

FLUID POWER AT WORK

Cited for Hydrostatic Transmission Work

Mr. Donald Firth, engineer at the National Engineering Laboratory, Department of Scientific and Industrial Research, England, has won the Wolfe Award for his outstanding work on hydrostatic transmissions.

Mr. Firth was cited for developing two types of transmissions. One is suitable for use aboard ship or on heavy earthmoving equipment. It is quiet, has a long life, and is efficient over a comparatively wide range of operating conditions. This unit features an improved axial piston, swash-plate pump which can also be used as a motor.

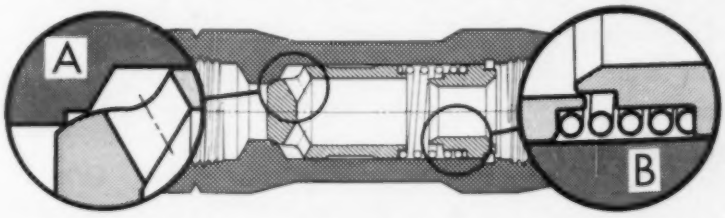
The second unit, is more economical and is already being used commercially on some machine tools. A vertical boring mill incorporating this hydrostatic transmission was recently shown at a machine tool exhibition in England. The transmission maintains a constant cutting speed even with changing stock diameter. It eliminates the need to change gears during cutting, and gives improved surface finish and easier machine control. The time required for a typical facing operation may be cut in half compared to that of a standard machine.

"Remember that non-return valve you designed? It works OK. We can't return."

COSTS LESS YET IT'S ALMOST IMPOSSIBLE TO WEAR OUT

New Check Valve from BRUNING

Every test we run on our new "Deccto" check valve shows it continues to function perfectly far longer than competitors. The explanation is apparent upon examining its design.



The spherical poppet, with its hardened mirror finish, engages with a knife-edged orifice (A) to produce a seal that won't leak regardless of pressure or temperature.

Surge-shock is eliminated by our poppet deceleration device (B), an unusual hydraulic cushion. Because of these new ideas in check valve design, the "Deccto" offers reliability at pressures of 3000 PSI and temperatures from -125° F to +500° F.

Despite the superior design and construction of "Deccto" check valves, prices are very low. It is no exaggeration to say they represent the best value obtainable anywhere. Samples will be sent on receipt of your specifications.

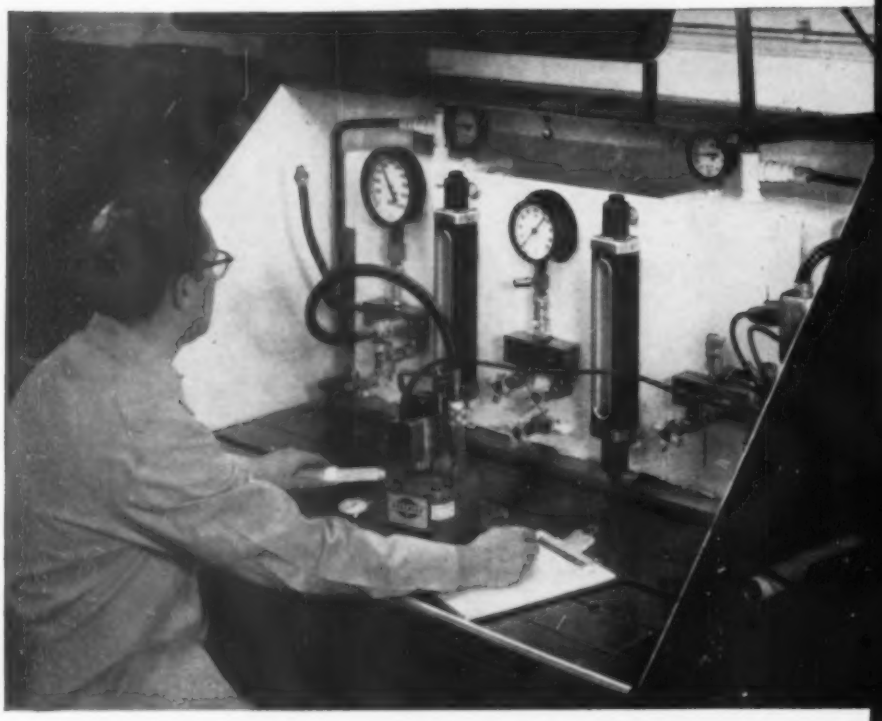
THE BRUNING COMPANY LINCOLN, NEBRASKA

Phone—HE 5-3511 • TWX—LI 8151

Circle **27** on Reader Service Card

PRINTED IN U.S.A.

Practical solutions to many of today's high-pressure (10,000 psi) hydraulic problems begin right here



. . . in the Greenlee Hydraulics Test Laboratory

Do you have a problem involving hydraulic pressures in the 10,000 psi area? Quite likely GREENLEE can be of help — either with our standard line of pumps and valves, or with adaptations engineered for your specific applications.

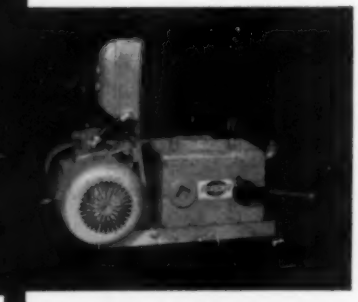
For many years GREENLEE has manufactured hydraulic equipment operating at high pressures. And as *specialists* in this field, our pump and valve engineers have worked closely with many other manufacturers on the development of a wide variety of mechanisms using 10,000 psi for plant, laboratory, or field use.

The hydraulics section of GREENLEE includes complete engineering, testing, and manufacturing facilities. Why not put them to work on your 10,000 psi problems? Write us today, outlining your requirements.

GREENLEE TOOL CO., 1970 COLUMBIA AVE., ROCKFORD, ILLINOIS

Specialists in high-pressure hydraulics GREENLEE

HIGH-PRESSURE, TWO-SPEED portable power pumps by Greenlee feature high volume, low pressure for fast-approach ram action and automatic change-over to low-volume, high-pressure drive. Lightweight series: 10,000 psi intermittent, 6,000 psi continuous. Heavy-duty series: 10,000 psi continuous. Portable—self-contained units. Choice of two-way or four-way valves.



HIGHER VOLUME, HIGH-PRESSURE Greenlee No. 797 power pump features extra-high-speed drive at high pressure. Up to 213 cu in. per minute at 10,000 psi. Pump, reservoir and control in one compact unit. Electric-motor or gasoline-engine driven. Choice of two-way or four-way valves. Mobile undercarriage optional.

GREENLEE HYDRAULIC VALVES for hydraulic systems up to 10,000 psi pressures. Two-way, three-way, four-way, flow control and free-flow metering types. (Four-way, spool type illustrated above.) Designed for integral or remote control of Greenlee pumps and for use on a wide variety of other hydraulic applications.

Ask for Bulletin E-248 describing Greenlee hydraulic pumps and valves.

Circle 69 on Reader Service Card

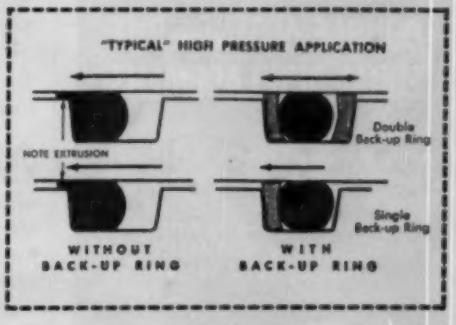
Circle 128 →

NOW – Increase O-Ring Life and Reduce Costs with...

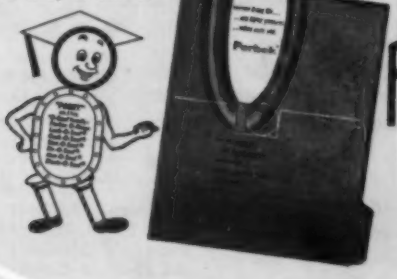
Parbak*

The only contoured and continuous back-up ring... simplified, easy-to-assemble, resists higher pressures!

Here's the first really new back-up ring in years . . . Test after test, both in the field and laboratory, has proved that Parbaks* greatly increase O-ring life. In addition Parbaks* improve lubrication, are easy to assemble, and resist higher pressures — *yet they actually cost less* than back-up rings for similar useage!



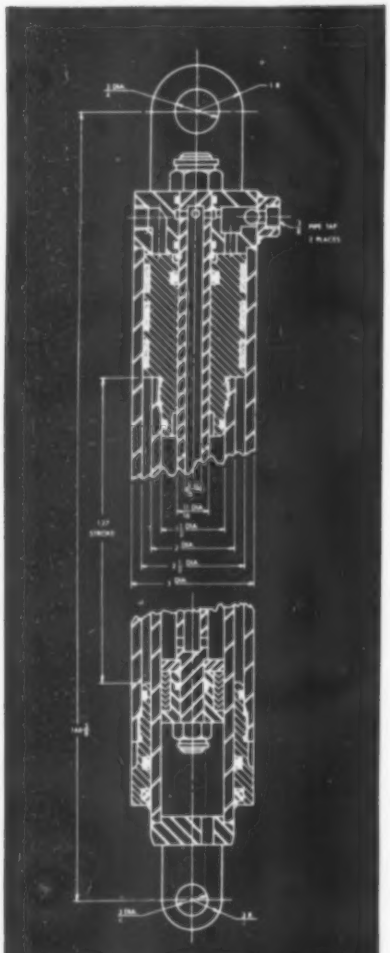
Why not get the facts about these unique rings, now. Send for catalog 5482 — 8 pages of design data and other material about Parbaks.* It's free, of course.



Parker SEAL COMPANY
Culver City, California and Cleveland, Ohio
A DIVISION OF PARKER-HANNIFIN CORPORATION

* Trade Mark

IMAGINATION FOR SALE!



DOUBLE ACTING – BUT EQUAL DISPLACEMENT

Does your application require a double acting cylinder that moves the same speed in both directions? One of our customers needed such a cylinder – a cylinder with equal travel speeds in both directions, an extremely long stroke and limited force.

Universal Hydraulics designed and built this simple, space-saving cylinder . . . an example of creative engineering. Let our imagination work for you . . . tell us about your application problem today.

UNIVERSAL HYDRAULICS

DIVISION OF HOLAN CORPORATION
4500 BEIDLER ROAD
WILLOUGHBY, OHIO
PHONE: 946-2100

Circle **165** on Reader Service Card

FLUID POWER AT WORK

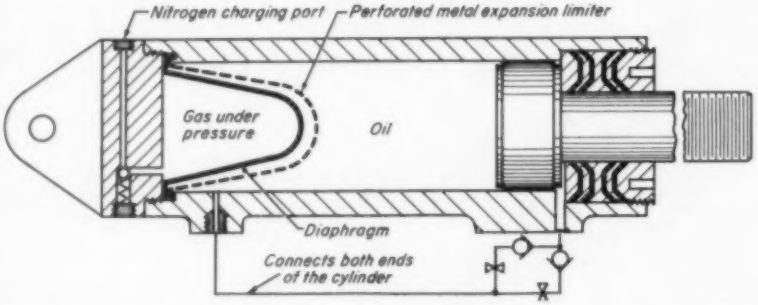
Book Review

Compressed Air and Gas Handbook

Third Edition, 592 pp, *The Compressed Air and Gas Institute, Cleveland*. $8.00.

Completely revised edition includes sections on air economy, maintenance schedules, lubrication, and compressor start-up. Centralized versus multiple-unit compressed air systems is also discussed. Other major subjects are positive displacement and dynamic compressors, plant air system design, pneumatic tools, air-operated equipment, and general reference data. Information is presented as simply as possible with wide use of tables and graphs.

Design of an adjustable shock absorber



In many industrial transfer operations it is not nearly as difficult to start heavy parts moving as it is to stop them without severe shock. This is particularly true when the parts are not attached to the transfer mechanism and travel free. Also when diversified parts are processed on a single line, each has a different deceleration requirement. This shock absorber lets you adjust for the required cushioning.

• **Compressed Gas Stores Energy**—The shock absorber is similar in appearance to a cylinder. It has a rod which attaches to a piston inside the shock absorber and extends through the end cap. The piston is held extended by oil which is pressurized by nitrogen. A synthetic rubber diaphragm separates the gas from the oil.

• **Operation**—When the piston rod is hit with a sufficient force, the gas compresses. At the same time, oil flows through the line bypassing the piston. Rate of flow is governed by the setting of a needle valve. This setting determines how much energy is dissipated by compressing the gas and how much by oil throttling.

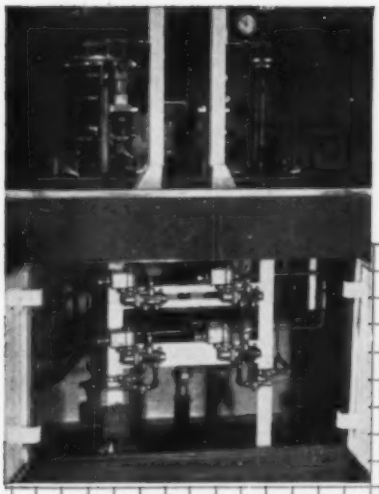
When the system equalizes after a shock, energy stored in the gas extends the piston. The velocity at which the piston extends is controlled by a second needle valve. Check valves prevent flow through the wrong needle valve.

Piston rod seals are designed to prevent air entering when a vacuum is created at the rod end on impact.

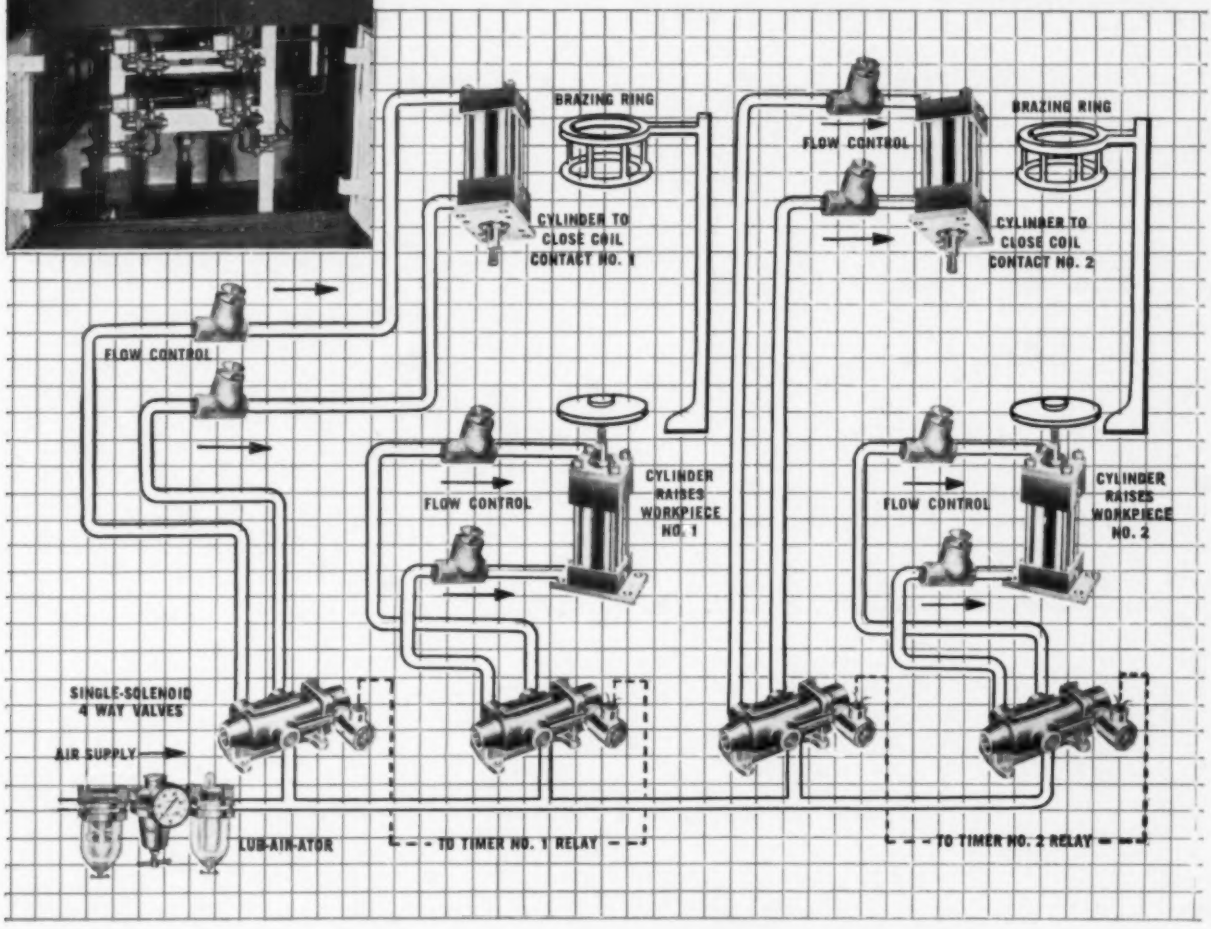
• **Design Requirements**—Three variables determine the shock absorber's performance.

1. Initial pressure of the nitrogen charge—Gas pressure in psi multiplied by piston area in sq. in. gives the minimum force in lbs at which the piston rod will move.
2. Ratio of gas volume to oil volume—The greater the volume of gas at the start, the more gradually the load decelerates.
3. Ratio of piston area to rod area—Increasing the ratio of piston area to rod area increases the stroke of the shock absorber, because more oil can move from the head end to the rod end. ▼▼▼

Information for this article was supplied by MICHEL C. GOCHTOVTT, *Manager of Engineering Design, Keasbey and Mattison Company, Ambler, Pennsylvania.*



General Electric Company's Apparatus Service Shop in Detroit, Mich., uses Schrader air circuits to actuate and control this brazing machine. It enables one man to braze 120 planet carrier gear assemblies for automotive transmissions in one hour. Double-acting cylinders, actuated by solenoid valves, lift the assembly into position within the coil for brazing the shaft to the gear, and lower it for water quench. JIC cylinders control the induction heating coil contacts. According to Frank A. Ross, the designer, Schrader's Flow Control Valves close contacts so gently that they perform 750,000 cycles before needing replacement. In addition, air works successfully in a strong magnetic field, and the circuits can be simple.



TOUGH BRAZING JOB BECOMES A BREEZE... WITH SCHRADER AIR CIRCUITRY

PROBLEM: Strong magnetic field . . . complex movement of parts . . . speed requirements . . . precise actuation of coil contacts.

SOLUTION: Simple Schrader air control of mass production operations.

Schrader Air Products are designed to operate together in varied combinations to produce practically unlimited results. Their quality and versatility make them capable of *simplifying* production . . . while speeding it up . . . at unmatched low cost. Are you failing to ultilize fully the air you already have? Follow this Detroit plant's example. Examine your production facilities with air in mind. Make many operations simpler and more efficient by applying any or all of the complete line of Schrader Air Control Products.

This new Schrader catalog is available at your Schrader distributor, who is stocked with the complete range of sizes and types of Schrader air circuitry products. Consult the Yellow Pages or write Schrader.

FULL LINES OF QUALITY AIR CIRCUIT COMPONENTS • OFF-THE-SHELF SERVICE AND INFORMATION FROM YOUR NEARBY DISTRIBUTOR • STAFFED WITH AIR CIRCUIT EXPERTS • CONSULT YELLOW PAGES OR WRITE FOR HIS ADDRESS

Schrader®
a division of SCOVILL

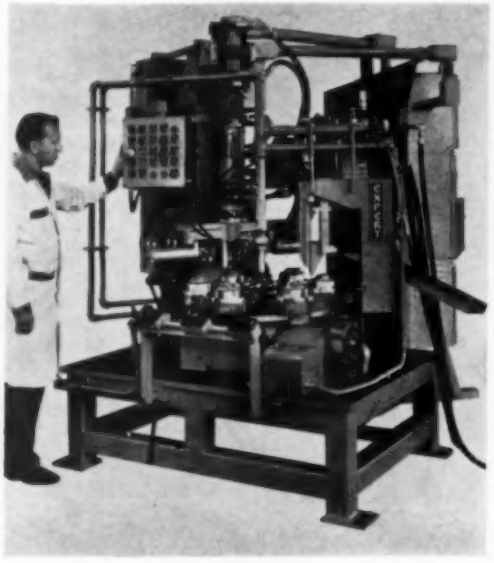
A. SCHRADER'S SON
Division of Scovill Manufacturing Co., Inc.
456 Vanderbilt Ave., Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

Circle **147** on Reader Service Card

FLUID POWER AT WORK

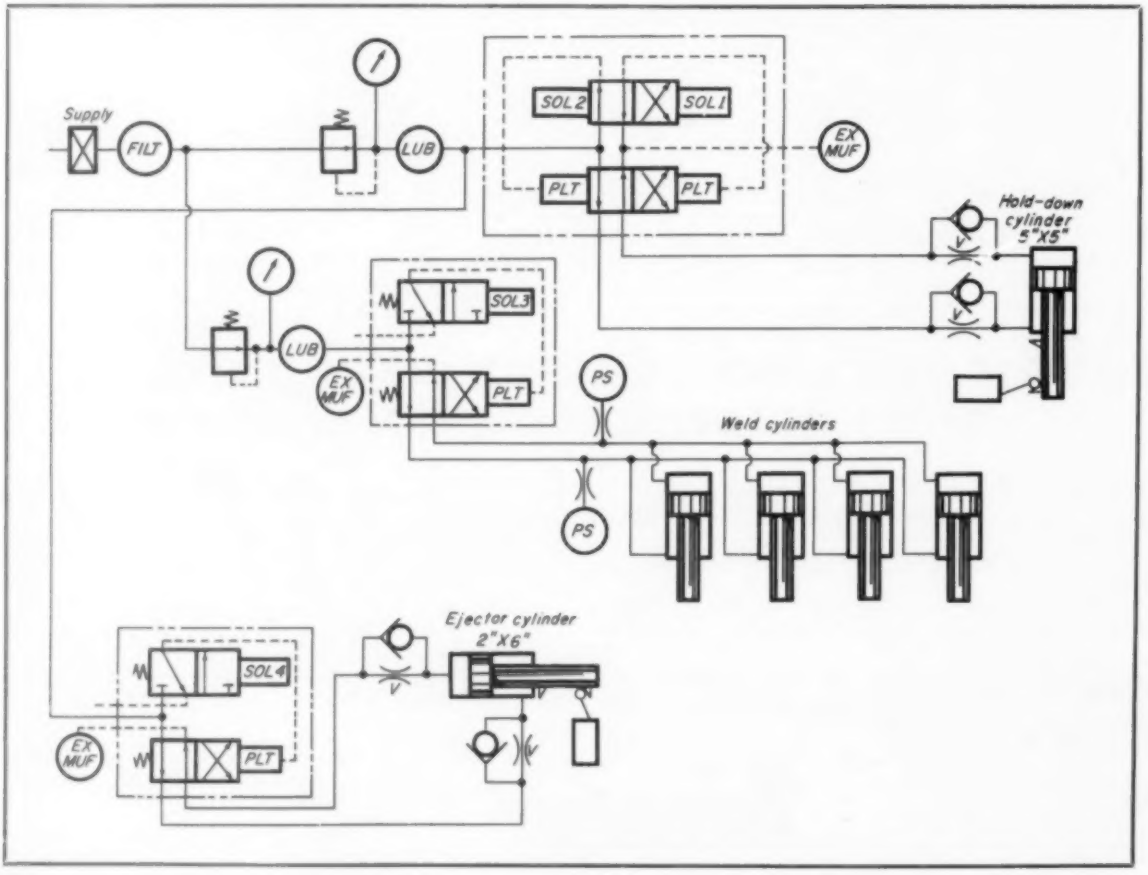
Air Cylinders Actuate Welder



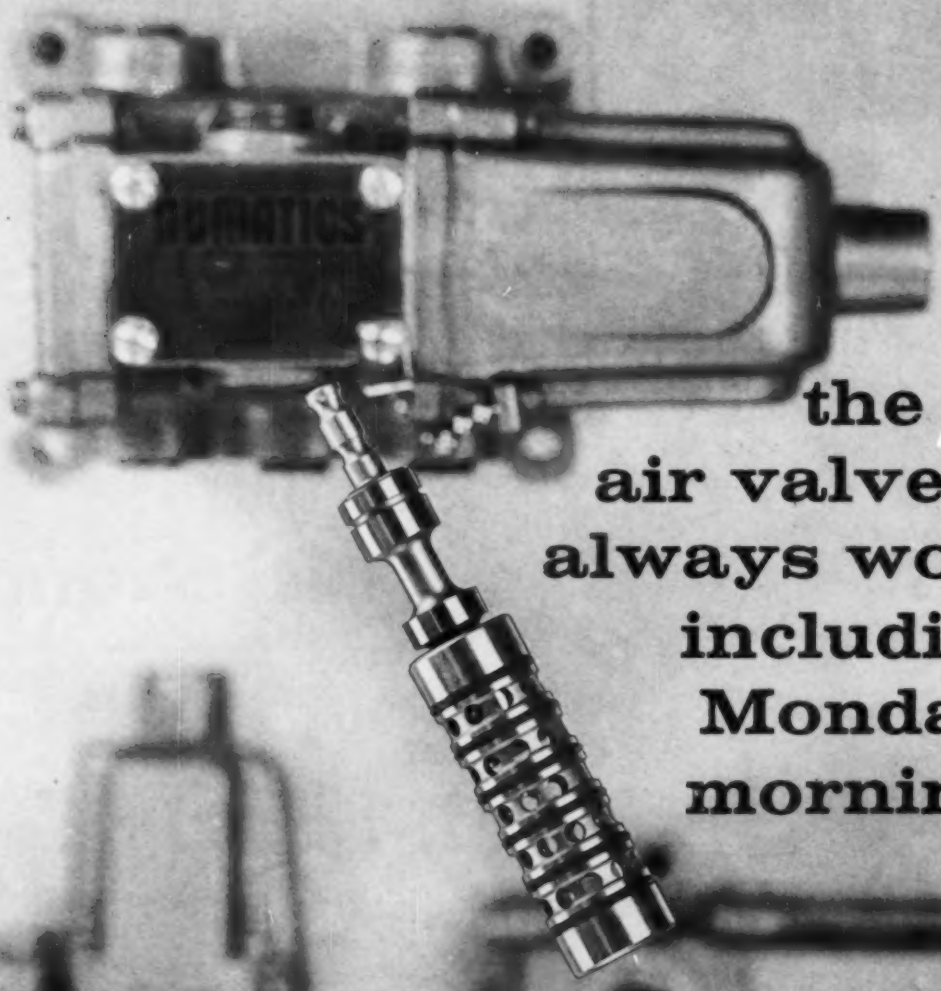
This pneumatic welder automatically projection welds horn motor cups to their base plates. The machine is manufactured by Expert Welding Machine Co., Detroit, Michigan.

The cups and base plates are loaded manually into a fixture. The hold-down control valve solenoid is then energized. It extends the hold-down cylinder and fixture which automatically aligns and holds the assembly in position. As the hold-down cylinder reaches the end of its stroke, it trips a limit switch that energizes the weld gun cylinder valve and starts the welding operation. Four projection guns weld cup to plate in four places.

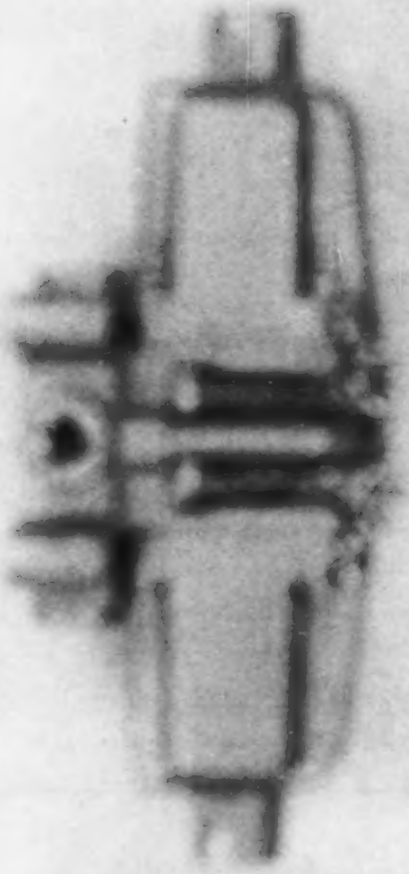
When welding is completed, the weld gun solenoid is de-energized, and the cylinders retract. This closes a pressure switch in the weld gun cylinder exhaust line, and energizes the opposite solenoid on the hold-down valve, retracting the hold-down cylinders. An ejector cylinder now actuates two fingers that remove the welded part from the fixture, and trip a limit switch that retracts the cylinder. After dwell time, the machine re-indexes for a new cycle. ▼▼▼



Circle 121 →



the air valve that always works... including Monday morning.



Numatics valves are the most reliable air valves made. They work now, and the next time you push the button. That includes Monday morning, after a weekend shutdown or even after months of shutdown.

There are no working resilient seals in a Numatics valve to seize after prolonged idleness. Only the hardened, stainless steel lapped spool and sleeve. Metal to metal contact? No. Millionths of an inch clearance and milli-seconds of smooth response? Yes.

You can run a Numatics valve dry, on standard lubricants, on dirty air, it always works.

From subminiatures through a wide range of full pipe sizes, Numatics valves operate from 28" Hg vacuum to 300 psi without alterations or external pilot lines.

Buy Numatics.

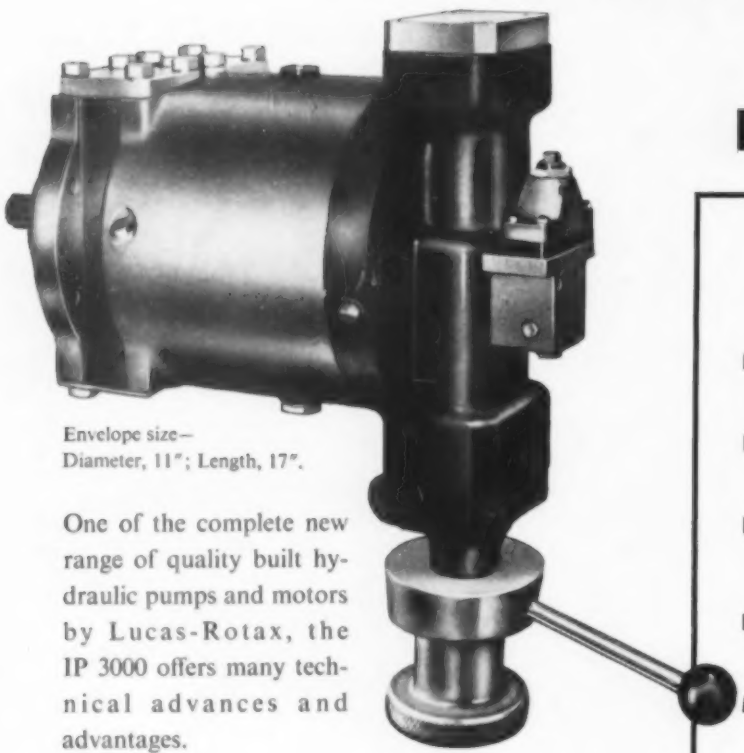
NUMATICS, Inc.

Highland, Michigan

Unmatched in performance, quiet... the reliable

NEW IP 3000 INDUSTRIAL HYDRAULIC PUMP

by LUCAS-ROTAX



Envelope size—
Diameter, 11"; Length, 17".

One of the complete new range of quality built hydraulic pumps and motors by Lucas-Rotax, the IP 3000 offers many technical advances and advantages.

- **Smaller size**
- **Lower weight**
- **Variable volume**
- **Low noise level at higher operating speeds**
- **Low cost**
- **High efficiency**
- **Fitted with pressure compensator as standard equipment**

For further information, contact the agent or office nearest you today, or write for technical literature.

PUMP DETAIL

	Basic Pump Fixed Stroke
Fluid displacement (cub. ins./rev.)	13.89
Nominal working pressure (peak)	5000
(lb. per sq. in) (continuous)	3000
Nominal speed (peak)	2000
(r.p.m.) (continuous)	1800
Input h.p. at 1,000 r.p.m. and 1,000 lb. per sq. in. differential	38
Max. Torque (lb./ft.) per 1,000 lb. per sq. in. fluid pressure differential	200
Recommended Inlet Pressure (p.s.i.g.)	60
Weight (lb.) Basic Pump	128
Operating temperature	–40 to 200°F

a product of creative engineering by

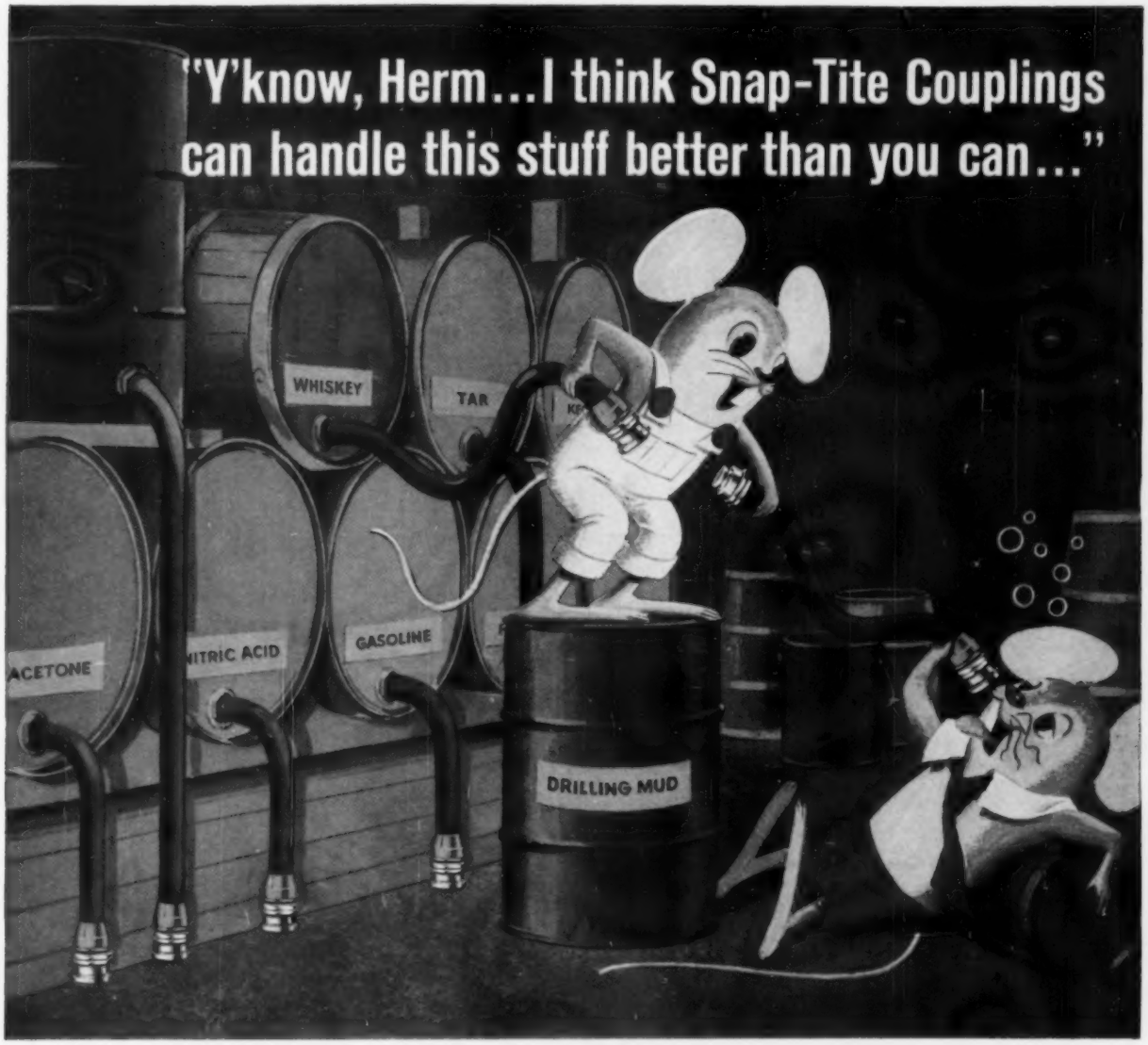
LUCAS-ROTAX LIMITED, TORONTO

LUCAS ROTAX

A member of the Lucas organization with OFFICES AND SERVICE DEPOTS THROUGHOUT NORTH AMERICA

BOSTON • NEW YORK • CHICAGO • LOS ANGELES • HOUSTON • SAN FRANCISCO • CLEVELAND
JACKSONVILLE • DENVER • SEATTLE • BALTIMORE • TORONTO • MONTREAL • VANCOUVER

6810

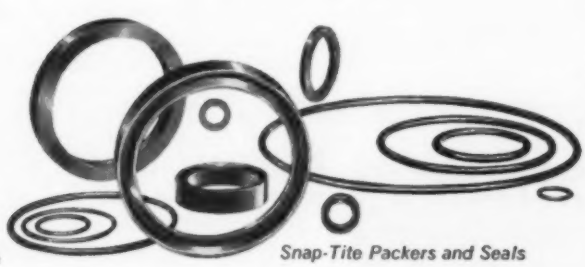


A complete choice of packers and seals permits Snap-Tite quick-disconnect couplings to handle over 600 different fluids! *(some of them mighty tough)*

Whatever fluid you're working with, chances are Snap-Tite couplings can handle it. Because every-one of the thousands of Snap-Tite quick-connect valved couplings comes with a wide choice of rubber packers and seals, selected according to the fluid in use. The right choice, of course, is vital for the seal is the very heart of the coupling.

To assist you in the proper selection of coupling seal material, Snap-Tite, with the assistance of suppliers of synthetic rubber materials, has recently compiled a comprehensive Packer Usage Guide —the first of its kind in the industry.

For the Packer Usage Guide, and for complete information on the correct choice of quick-connect, quick-disconnect couplings for the fluids *you* use, write Snap-Tite, Inc., Union City, Pa.



Snap-Tite Packers and Seals

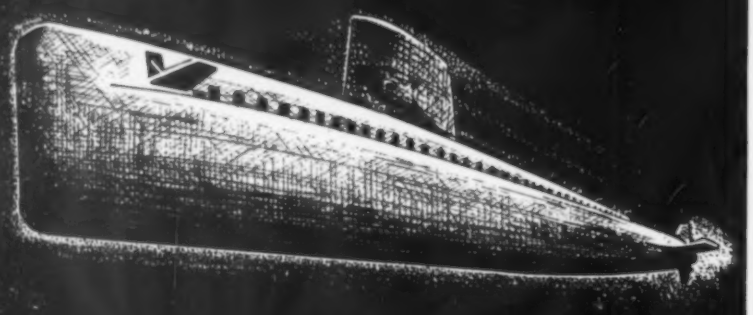
Snap-tite

UNION CITY, PA.

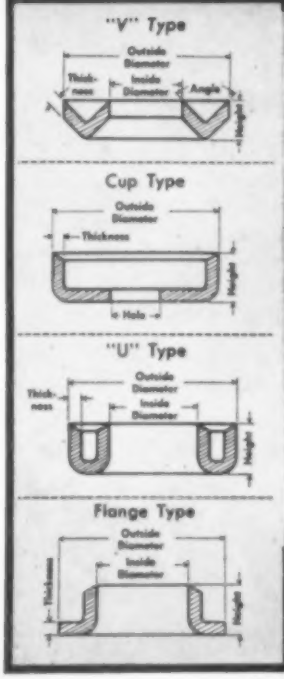
ST-61-02

K-8129

WE KNOW OUR PRODUCTS ARE DEPENDABLE!



In a Sub, it is imperative that every part of the hydraulic system is functioning to peak performance. It is easy to see, also, the importance of dependable packings within other equipment such as Hydraulic Jacks, Road Equipment, Milking Equipment, etc., for which Page Packings are selected. This faith in Page's Vee's, Cups, U's, and Flanges has lasted for decades, maintained through constant inspection of highly selected leathers, and craftsmanship coupled with a very experienced engineering staff.



PAGE HAS THE LEATHER FOR EVERY SPECIFICATION

STANDARD OAK — Recommended for average conditions of cold water, oil, and air pressure. Oak leather is not recommended for water that is too hot for the hand to stand.

HERCULES RETAN — Recommended for general hydraulic and pneumatic use. This "top grade" leather is highly resistant to heat and friction, and offers a greater wearing quality for applications that demand a more durable packing.

BLUE CHROME — A mineral tanned leather for use in specalized applications. Withstands high pressures as well as extreme conditions of heat, gas, and acid fumes.

Every Packing Problem Deserves Our Attention. Send Us Your Problems for Recommendations.

PAGE BELTING CO.

CONCORD, NEW HAMPSHIRE

Circle **124** on Reader Service Card

FLUID POWER AT WORK

Hydraulic Dozer Converts to Front-End Loader

A conversion package has been released by the Frank G. Hough Co., Libertyville, Illinois which makes this hydraulically actuated bulldozer into a front-end loader.

Cylinder mounting trunnions, hose connections, and fittings are readily usable when converting from one machine to the other. The tractor has a closed hydraulic system. Two vane pumps give it the capacity to maneuver the cutting blade and actuate the twin steering cylinders.

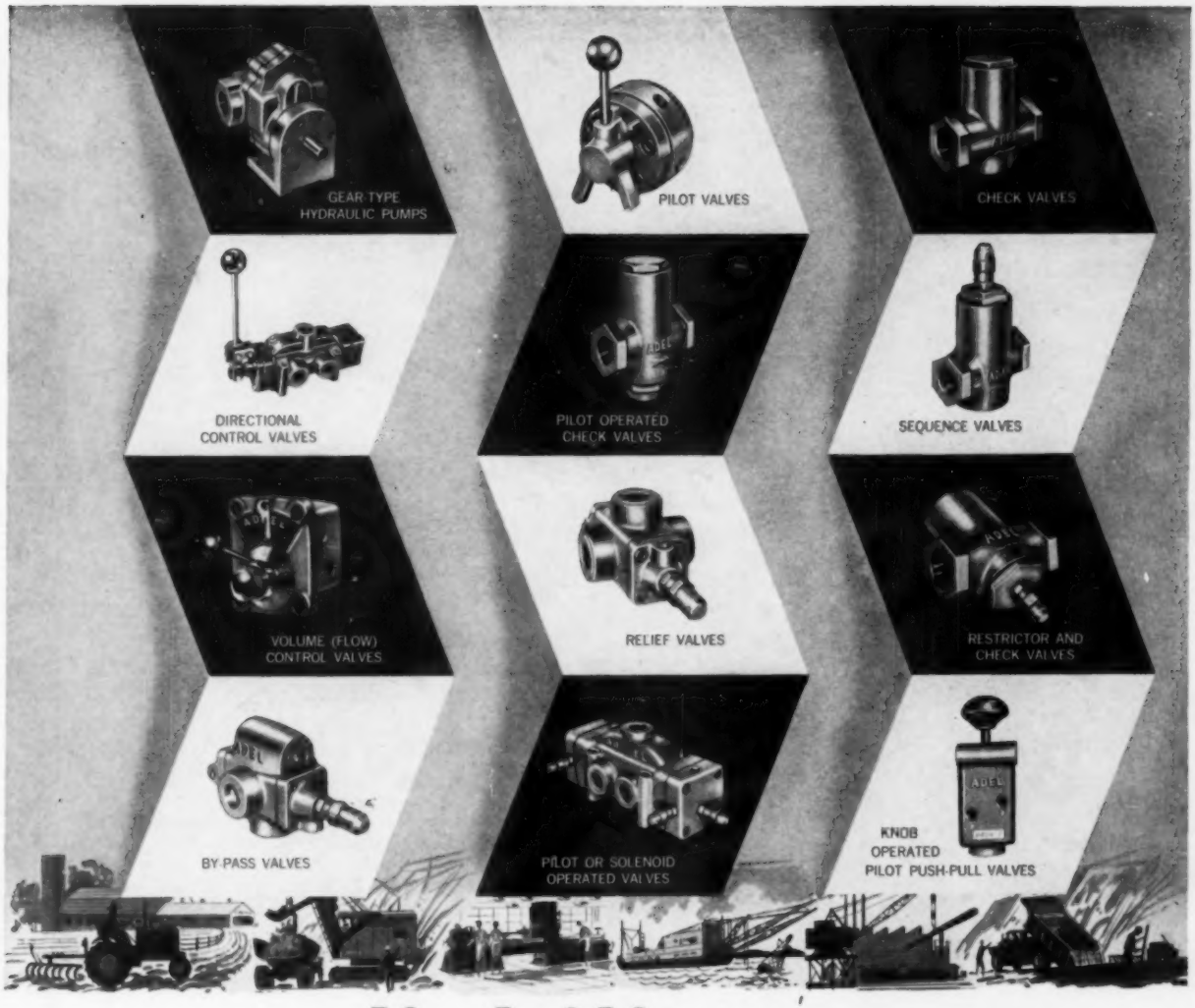
FPS News

The Fluid Power Society has been formed to further the development and use of fluid power. Membership information is available from headquarters at 5595 N. Hollywood Ave., Milwaukee 17, Wisc.

Annual meeting to stress education

"Training the Users of Fluid Power" will be the theme as members of the Fluid Power Society meet next month in Chicago. The one-day meeting, scheduled for October 18, just before the National Conference on Industrial Hydraulics, is being planned by George Altland, chairman of the program committee and Max Covert, vice chairman. The society's

Continued on page 46



reliability / ADEL PRECISION HYDRAULIC EQUIPMENT

....synonymous for fail-safe performance!

A complete line of valves and pumps for every application ADEL contributes cost-savings to the Original Equipment Manufacturers, not only in terms of initial cost, but in design features that provide preventive maintenance and, most important, *maximum operating efficiency over the years.* ■ If you need a hydraulic valve or pump replacement for your equipment... *specify* ADEL and you won't need another! ■ **You name the application...** ADEL has the Precision Hydraulic Equipment to meet your requirements. ■ *Write for complete engineering specifications.*

Designers & Manufacturers of Industrial & Marine Hydraulic Control Equipment

Reliability ADEL **PRODUCTS DIVISION**

1444 WASHINGTON AVENUE,
HUNTINGTON 4, WEST VIRGINIA
DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE U. S. AND CANADA

A DIVISION OF GENERAL METALS CORPORATION

A SUBSIDIARY OF TRANSAMERICA CORPORATION

HANNIFIN
has a faster, more rugged
AIR MOTOR

Truly a convenience package, the Hannifin Air Motor combines a rugged, low-friction, double-acting air cylinder with a solenoid valve. Ample air passages permit rapid cycling. Built-in speed controls make it possible to slow either or both strokes. Mounting dimensions interchange with most existing applications. "Off shelf" delivery in "standard" strokes. Bulletin 215—free on request—describes this new product.

PARKER HANNIFIN CORPORATION
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
HANNIFIN COMPANY
A DIVISION
545 South Wolf Road • Des Plaines, Illinois
EUROPEAN DIVISION • PARKER-HANNIFIN N.V. SCHIPHOL • THE NETHERLANDS
Circle 76 on Reader Service Card

FLUID POWER AT WORK

House of Delegates will meet at 9:30 AM at the Sherman hotel to discuss revision of membership qualifications for students, multiple membership, local chapter dues, revisions to by-laws, election of the nominating committee, standards, and educational activities. A general luncheon will be followed by a speaker, and at 2:00 PM, the general session will meet. Reports will be presented by officers and the board of directors. These will emphasize objectives in education and standardization.

BRIEF NOTES

ADEL BUYS VALVE LINE . . . Fred D. Marcum, vice president and general manager of Adel Products, Huntington, W. Va., has announced the acquisition of the Pathon line of hydraulic valves from the Pathon Manufacturing Co., Cincinnati. Pathon industrial hydraulic valves are used in 2000 to 3000-psi systems.

COMMERCIAL FILTERS MERGER RECOMMENDED . . . Directors of Commercial Filters Corp., Melrose, Mass., and RAD, Inc., a Cincinnati research and development firm, have recommended a merger of the two companies. The proposed merger now requires stockholder approval. Commercial Filters makes filters for liquids and gases used in missile, chemical, petroleum, nuclear energy, and other industries.

PRICE OF TEFLON REDUCED . . . Prices of Teflon FEP-fluorocarbon film have been reduced by $3 a pound. This is the second reduction in six months and brings the price of Teflon FEP films two-mils or thicker to $10 a pound. One-mil film is $11.50, and half-mil film is $15 a pound.

SHUMAKER TO HEAD ASME . . . Clifford H. Shumaker has been named President of the American Society of Mechanical Engineers. His term in office will begin in June 1962. Professor Shumaker is chairman of the Department of Industrial Engineering at Southern Methodist University, Dallas, Texas.

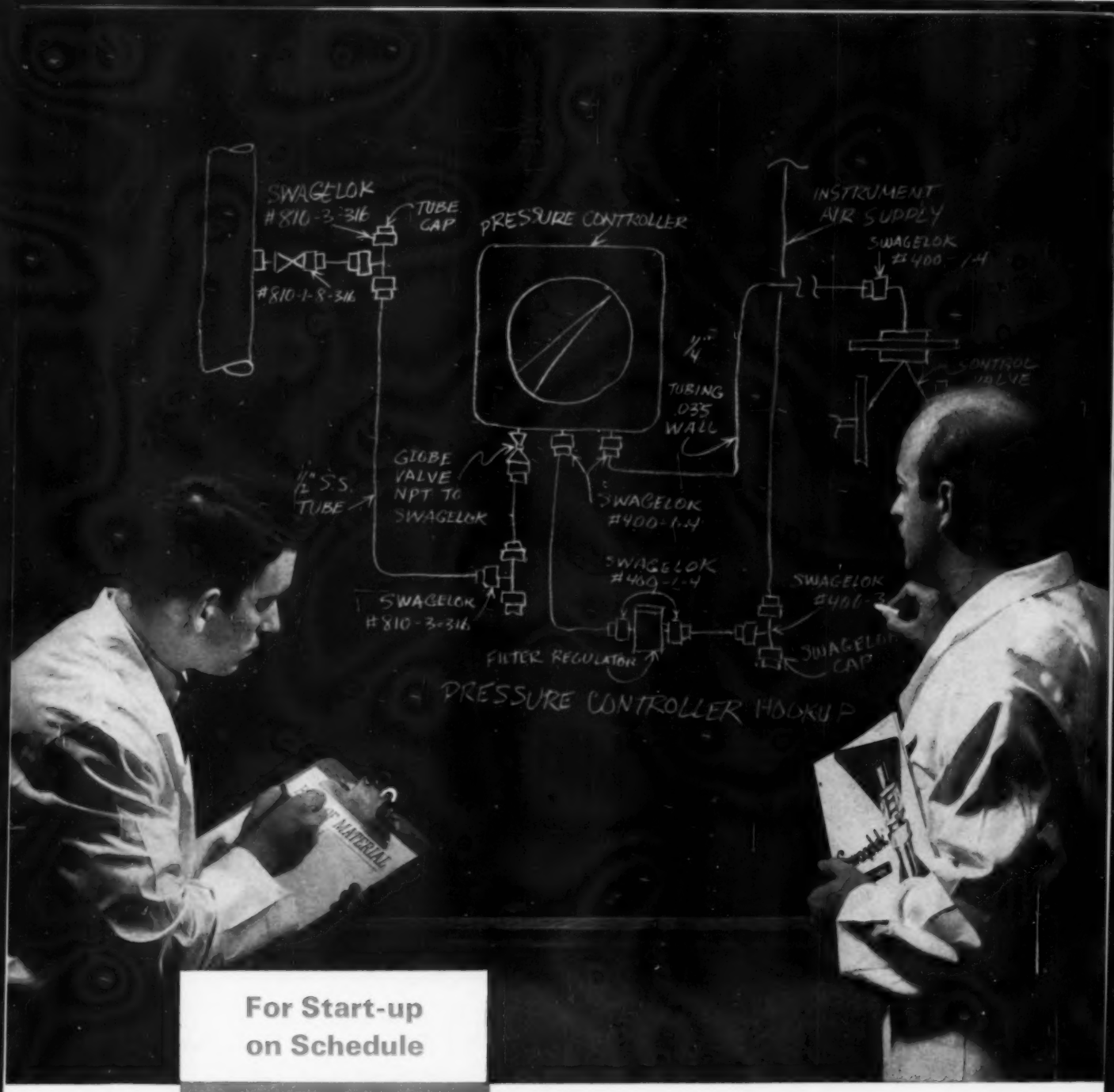
EDUCATIONAL EXHIBIT ON PNEUMATICS . . . Ross Operating Valve Co., has developed a mobile educational exhibit to aid industry in the fundamentals of air power and its control. The demonstration covers properties of compressed air, phases of air systems, valve types, functions, and operation. Actual air circuits are connected and operated.

PALL CORP., TRINITY MERGE . . . Pall Corporation has announced its merger with Trinity Equipment Corp which will continue to operate as a wholly owned subsidiary of Pall Corp. Trinity manufactures dry air and gas systems, thermowells, and thermocouples. Pall makes porous metal filters for airborne and industrial applications.

FLICK SPEAKS ON CYLINDER DESIGN . . . Frank Flick, President of the Flick-Reedy Corp., will address the Milwaukee Chapter of Fluid Power Society on September 27. His talk is titled "Cylinder Design and Application Concepts." The meeting has been set to concur with the Seminar on Hydrostatic Transmissions being held at the Milwaukee School of Engineering. Both events will be held at the school's Allen-Bradley Hall of Science.

JAMESBURY TO BUILD NEW PLANT . . . The Jamesbury Corporation, Worcester, Mass., has broken ground for a new 87,000 square foot plant. The new facility was dedicated as Goddard Industrial Center in honor of the late Dr. Robert H. Goddard, recognized as a pioneer of modern rocketry.

Circle 38 →



For Start-up on Schedule

Don't Let Leaky Connections Cause Expensive Delay at Start-up

These engineers are specifying Swagelok for plant construction. The most severe test of tube fitting design and quality is in plant construction. Many plants have been built using 10,000 to 20,000 or more Swagelok tube connections without a leak. You can spend days to find one leak among the thousands of tube connections on a construction job.

Insure plant start-up on schedule—specify Swagelok

CRAWFORD FITTING COMPANY, 884 East 140th St., Cleveland 10, Ohio
CRAWFORD FITTINGS (Canada) LTD., Niagara Falls, Ontario, Canada

SURGEPRUF®

Can supply "swaged-on" hydraulic hose assemblies for any application you specify!

Surgepruf offers greater freedom in designing new products and installations! Whatever the industry application, Surgepruf will furnish the finest swaged-on hydraulic hose assemblies to meet the specifications of your plans. Low, medium, medium-high and high pressure assemblies are available. All are factory assembled. All provide a superior leak-proof fluid seal with no braid exposure. They are quality controlled to strict Stewart-Warner standards.

Surgepruf hose has a wear and abrasion resistant neoprene cover. Buna-N seamless inner tube is securely bonded to wire or fabric braid—takes severest wear in stride. Hose temperatures range from –40°F. to plus 275°F. All Surgepruf hose meet SAE Hydraulic Standards for working pressure and burst requirements.

Precision machined Surgepruf standard steel couplings are zinc-dichromate finished to resist corrosion. Couplings are available in a variety of standard types, thread sizes and choice of metals.

Discover the design flexibility possible with Surgepruf "Swaged-on" hydraulic hose assemblies. Send for a FREE, illustrated catalog—#40-37—for a full description of the Surgepruf line.

NHAMA

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

Dept. AG-9I, 1850 Diversey Pkwy., Chicago 14, Illinois

In Canada: Stewart-Warner Corporation of Canada, Ltd. Belleville, Ontario

FEATURED IN CONTROL SYSTEMS OF MISSILE PROGRAM!

New FLOW CONTROL VALVES

pressure compensated

From **RIVETT**

Rivett Hydraulic Flow Control Valves are *now* being introduced to the trade after four years of thorough field testing in advanced applications for both government and industry. These valves may be used as ordinary "meter in," "meter out," or "bleed off" types of compensated flow control valves by keeping the bypass port plugged in the subplate, and piping the "inlet" and "outlet" ports as desired. This usage means excess oil is spilled over a relief valve so pump is always at full horsepower.

On some meter-in circuits, with the "bypass" port piped to tank, the "inlet" and "outlet" can be piped as above, but any excess oil fed to the valve will flow to tank. As long as the fluid motor or cylinder is working at less pressure than system relief valve setting, the Rivett 3-port flow control will maintain oil flow to the work as set, the bypass port will flow excess oil to tank at the work pressure, and therefore the pump is using horsepower only at the rate determined by work requirements.

FEATURES

1
Knife edge orifice positively assures consistently uniform low flow; and minimizes change of flow when change of fluid temperature occurs.

2
No drain connection required because special pressure balanced Teflon seals are used.

3
Maximum flow capacities up to 125 G.P.M. in 1½" size are standard.

4
Valves are usable as two port and three port models.

5
Vernier knob has provision for safety lock wiring.

6
Valves are available with return free-flow check.

RIVETT, INC.

Dept. HP-9, Brighton 35, Boston, Mass.

The Better You Know Hydraulics — The Better You Like

RIVETT

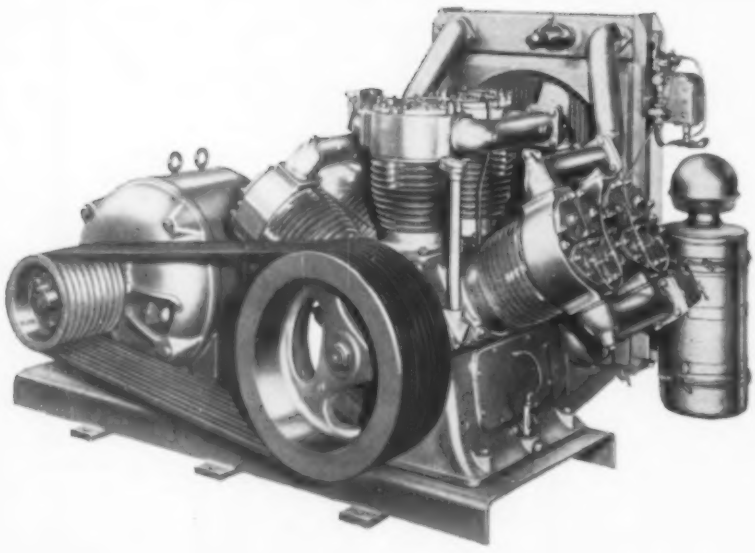
Circle **142** on Reader Service Card

Make LE ROI your one-stop source for AIR COMPRESSORS

WESTINGHOUSE unit type ½ to 15 hp. 17 models: 2 to 71.7 cfm—80 to 250 psi

WESTINGHOUSE single- and two-stage compressors are ideal for jobs in the unit type class with moderate air demand. You get long-lived dependability at low first cost. Upkeep is negligible. Units incorporate thermal overload protection, positive starting unloader, air cooled deep-finned cylinders, and corrosion-resistant automatic spring loaded floating valves.

Crankshaft is ball-bearing mounted for stability, and matched V-belt set assures balanced drive line wear. Compressors are available with horizontal or vertical tank, or bed-plate mounting. Load-unload or start-stop control is standard. Options include dual control, water-cooled aftercooler, and automatic drain valve for receiver.



LE ROI stationary type 25 to 100 hp. 4 models: 92 to 450 cfm at 125 or 175 psi

LE ROI stationary compressors provide economical and flexible air power for your heavy industrial jobs. Made in 25, 50, 75, and 100 hp sizes, these two-stage units can be used as central air supply — or you can spot units at various points of use, thus minimizing pipe runs and air loss. Air-cooling permits indoor and outdoor use, and compactness conserves space.

Features like forced-feed lubrication, large intercooler, high-speed fan, and balanced design extend motor and compressor life and cut upkeep. You can pick standard models with either dual control or continuous running load-unload control. Option extras include: crankcase oil filter, oil pressure safety switch, intake silencers, belt and intercooler guards, and water-cooled intercooler.

Ask your Le Roi Distributor for additional information. Or send for Bulletin SG-3 covering the entire line. Write to Le Roi Division, Westinghouse Air Brake Co., Sidney, Ohio.

SC-102

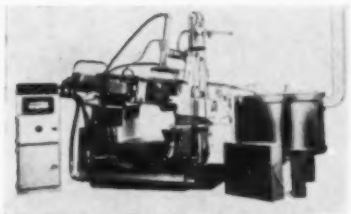
LE ROI Division of Westinghouse Air Brake Co. Sidney, Ohio

FLUID POWER AT WORK

HYDRAULIC POWER UNIT made by Huck Mfg. Co., Detroit is driven by a gasoline engine and mounted on a two-wheel trailer for cross-country hauling. This unit consists of engine, pressure-compensated gear pump, reservoir, fluid cooling system, and hydraulic pipes and valves. Capable of 10 hours continuous operation, it is used mainly for outside on-the-job fabrication work. It will operate many hydraulic installation tools at pressures to 5,000 psi.

The power unit has combination valve incorporating a 4-way directional valve, high pressure relief valve, and idler valve which insures enough pressure in the return hose for positive pintail ejection following fastener installation.

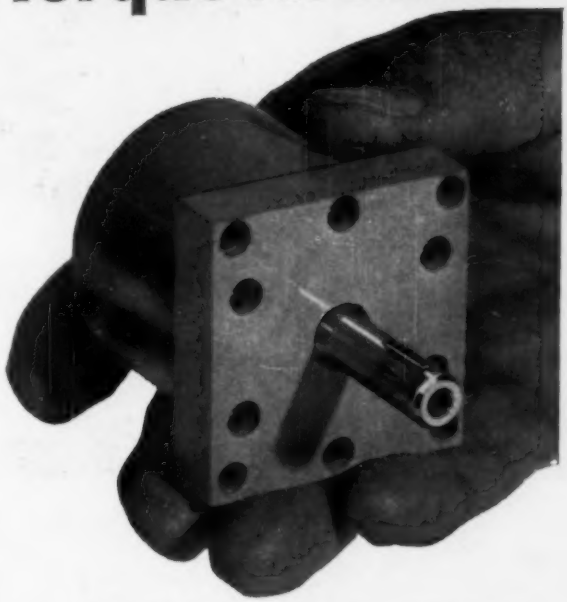
An air-cooled heat exchanger maintains oil reservoir temperature at 16 F above ambient.



AIR-CONTROLLED DIE CASTING MACHINE, made by DCMT Ltd., Port Washington, N. Y., has a poppet valve mounted directly in the head of the air cylinder, with a large entering air line. To eliminate back pressure caused by air exhaust friction, little air is left on the underneath side of the cylinder. This area is replaced by a large piston rod. Thus a rapid stroke occurs with no air cushion on the underneath side of the injection stroke. In addition the heavy piston increases the kinetic energy and acceleration of the plunger as it travels on the downstroke.

HYDRAULIC RAM provides angle shear with full tonnage power throughout its stroke. Shearing is smooth and impact-free. Ram is the only moving part in this machine. The use of hydraulics provides the operator with positive control of the ram at all times. Any attempt to shear material beyond the machine's capacity dumps oil over the relief valve and stops the ram at its rated tonnage. Manufactured by W. A. Whitney Mfg. Co., Rockford, Ill.

New Rotac MIDGET Rotary Torque Actuator



Use it to lift, lower, turn, rotate, index, clamp, transfer, toggle, press, load, unload, oscillate or turnover.

Mount it vertically, horizontally, or at any angle.

Rotate or oscillate it in any arc to 270° with either keyed shaft or body rotating.

Power it with air, oil or fire-resistant fluids.

Control it with simple valving for starting, stopping, slowing-down or speeding-up.

Apply it wherever you need instant torque and controlled rotary power. Current uses include: instrument and computer designs, small parts handling, remote control of valves and switches, and other light applications.

Count on it to measure-up to your needs. New Midget Rotac is only 2" x 2" x 2", weighs just 12 ounces (single vane model), with torque ratings up to 80 inch-pounds at 300 psi input (double vane model).

Examine its design by sending today for free design data book—gives engineering data, power ratings, mounting details. Or call your Rotac Representative for details.

EX-CELL-O FOR PRECISION

XLO EX-CELL-O CORPORATION 61-4RO

Greenville Plant, 945 E. Sater Street • Greenville, Ohio

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

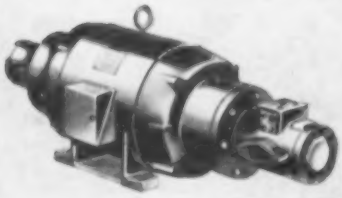
Circle **52** on Reader Service Card

← Circle **101**

BURGMASTER USES THESE VICKERS COMPONENTS

POWER PACKAGES—A complete Vickers 30-gallon hydraulic power supply was custom-designed and built for this machine. Vickers offers standard and custom power packages to meet every type of application need. Get details from your Vickers application engineer.

DIRECTIONAL VALVES—Two types of directional valves—solenoid operated and solenoid controlled, pilot operated—are used on this Burgmaster machine. The complete Vickers line of two- and four-way directional control valves is described in Catalog 5001C.



MINIATURE DIRECTIONAL CONTROLS—Series D1L two and four-way valves are designed for low volume systems, are suitable for operation to 1000 psi and have 2 gpm capacity. Low current a-c and d-c solenoids are available in all standard voltages. Write for data sheet D1L-1.

MOTOR PUMPS—A 5 HP, double-end motor pump is used on this Burgmaster. The complete Vickers motor pump line offers single, double, two-pressure and two-stage pumps. Use of these motor pumps conserves space and eliminates alignment problems between pump and motor. Details are available in Catalog 5001C.

VICKERS®

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

Department 1474 • Detroit 32, Michigan

FUTURE EVENTS

SAE PRODUCTION FORUM & ENGINEERING DISPLAY

Combined SAE Farm, Construction, and Industrial Machinery; Power Plant; and Transportation Meetings.

September 11-14

Milwaukee Auditorium

HYDROSTATIC TRANSMISSION SEMINAR

September 27

Milwaukee School of Engineering

SAE A-6 COMMITTEE MEETING

Aerospace Hydraulic & Pneumatic Systems & Equipment.

Week of September 25

Ramada Inn
Phoenix

SAE AEROSPACE ENGINEERING & MANUFACTURING MEETING

October 9-13

The Ambassador
Los Angeles

AMERICAN ROCKET SOCIETY 16TH ANNUAL MEETING & SPACE FLIGHT REPORT TO THE NATION

October 9-15

New York Coliseum

FLUID POWER SOCIETY ANNUAL MEETING

October 18

Sherman Hotel
Chicago

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS

October 19-20

Sherman Hotel
Chicago

43RD NATIONAL METAL EXPOSITION & CONGRESS

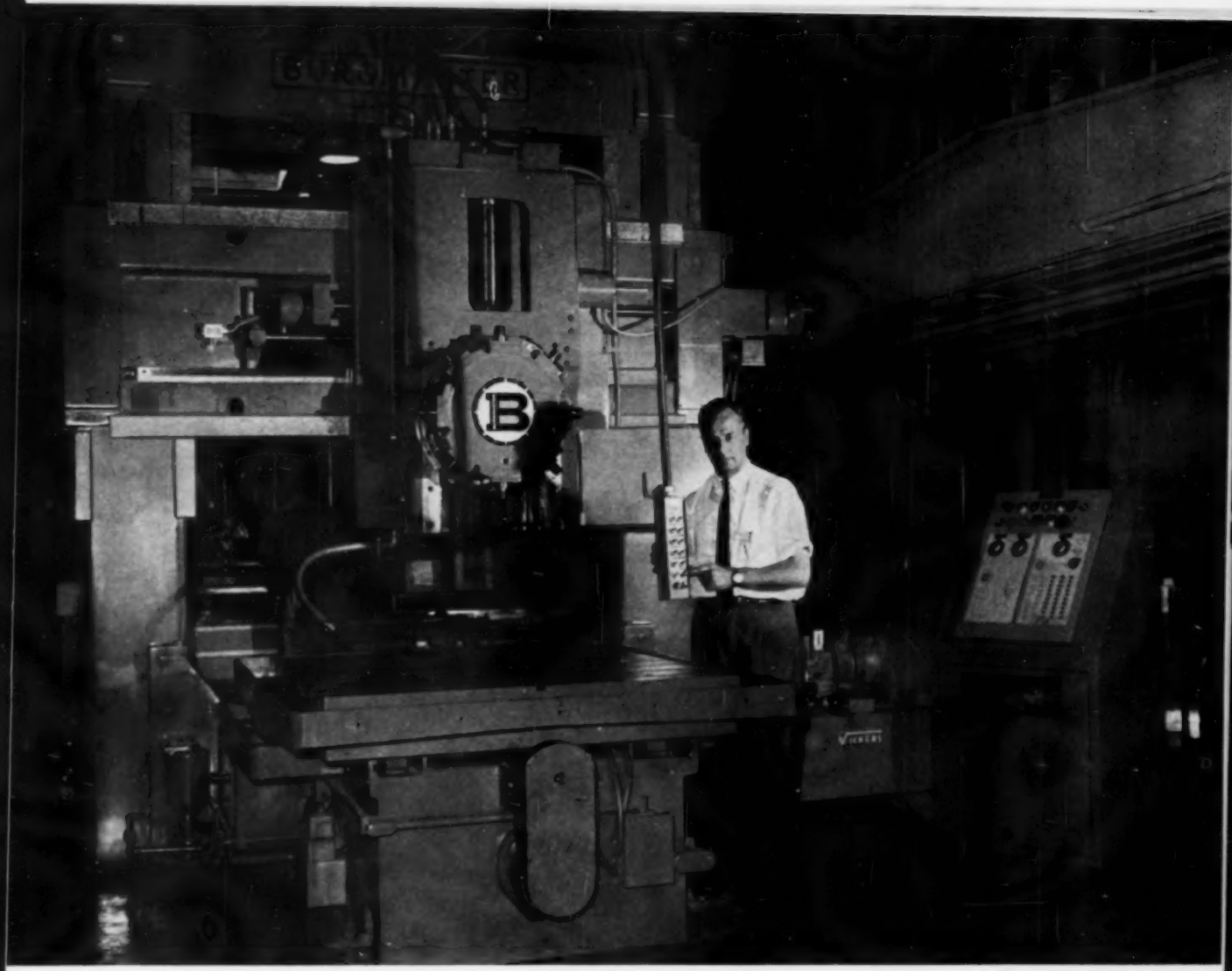
October 23-27

Convention & Exhibits Bldg.
Detroit

NFPA FALL MEETING

October 24-26

Sheraton Hotel
Philadelphia



ANTTI RAIHA, CHIEF ENGINEER, BURGMASTER CORP. SAYS:

"Hydraulic and tape controlled turret drills need sensitive, reliable power systems..."

". . . in order to control tool penetration and table positioning where location tolerances must be held to .001-inch. We've worked with Vickers hydraulic power systems since 1951, beginning with our automatic hydraulic models, we are increasing our activity in this area as the demand for turret drilling machines and tape controlled machines grows.

"In addition to the machine shown, we use Vickers hydraulics on seven different standard models as well as on many specially designed variations of these standard machines. We rely on Vickers hydraulic power systems, not only for their unusually high quality, but because they are easy to maintain and we have the additional assurance of the availability of their worldwide service organization.

"Because Vickers application engineers have given us close cooperation and have a thorough understanding of our requirements, we've been able to develop systems that provide long, trouble-free life."

Whether you are building standard or special purpose machinery, your power and control requirements can be met precisely and economically by the proper application of hydraulic systems. Typical Vickers components and systems used by Burgmaster are shown on the facing page. They are part of the broadest line of top quality hydraulics available anywhere.

VICKERS®

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

Department 1474 • Detroit 32, Michigan

Circle **166** on Reader Service Card

Here are tips to help you achieve packing-fluid compatibility!

The efficiency, safety and ultimate cost of a hydraulic system is largely dependent on the compatibility of its packings and fluid medium . . . how well they do or do not work together.

Mineral Oils

The above is frequently overlooked when a plant switches from one type of fluid to another. Take *mineral oils*, for example. Three general types are used in hydraulics, and are classified according to their aniline points: high, medium and low.

If, through error, a high aniline oil is used where low aniline oils are specified, rubber seals in the system would shrink and harden. Conversely, "high aniline" rubber seals will swell and soften in low aniline hydraulic oils. Leakage or equipment failure is the result.

To complicate the picture further, mineral oils made to the same specification by different oil manufacturers, using different crudes, will vary in aniline point to the degree that they may cause synthetic rubber seals to either shrink or swell.

Even among the various types of synthetic rubber used for hydraulic seals, the reactions to mineral oils vary. Buna S and Butyl seals, for example, will disintegrate in mineral oil while Buna N, Neoprene, Viton and Thiokol polymers work very well.

Fire-Resistant Fluids

In many hydraulic systems, *mineral oils* are being replaced by modern, synthetic fluids which eliminate fire hazards without affecting hydraulic efficiency.

Three types of fire-resistant fluids are in wide usage and each type requires a *compatible* packing.

The three basic types of synthetic fluids with *recommended* and *maximum recommended* operating temperatures are shown in the box.

Type	Recommended Temperature	Maximum Recommended Temperature
Phosphate Ester	+130°F.	+180°F.
Water-Glycol	120°	150°
Emulsion water-oil	120°	150°

Phosphate Ester fluids and mineral oils have a directly opposite effect on the same rubber seals. Butyl packings which fail miserably in mineral oils, work beautifully with straight Phosphate Ester while Buna N, which works well in mineral oils, is unsuitable for Phosphate Ester. For this reason, changing a system from mineral oil to Phosphate Ester requires a complete and careful flushing and cleaning *as well as a switch in packing materials*, if elastomer packings are used.

For use with these fluids, homogeneous packings should be of Butyl, fabricated packings of Butyl and duck or asbestos and leather packings should be either Wax or Thiokol impregnated.

Water-Glycol fluids are generally compatible with both Buna N and Butyl seals, and with duck or asbestos. However, they do attack leather fibers. Water-Glycols have a pH of 8.5 to 10.5 and leather fibers start to disintegrate at a pH over 8.0

Because of this pH condition, leather packings are not recommended for use with Water-Glycols. Homogeneous packings should be of Buna N and fabricated packings of either asbestos or duck and Buna N.

Emulsion type fluids react much the same as mineral oils do with rubber and leather. In homogeneous and fabricated packings, use Buna N; in leather, use a filler of wax or Thiokol. Never use Emulsion fluids with Butyl.

A Simple Solution

As complex as the subject appears, packing-fluid compatibility in hydraulic systems can be determined with very little trouble. Houghton Packing-Fluid Compatibility Tables will instantly tell you which packings work best with the various types of fluids in general use.

Better yet, Houghton is in a unique position to give you completely unbiased answers to your hydraulic packing-fluid problems, for **Houghton is the only manufacturer who offers you a complete line of both packings and fluids for industrial hydraulic systems.**

FREE! Packing-Fluid Compatibility Tables

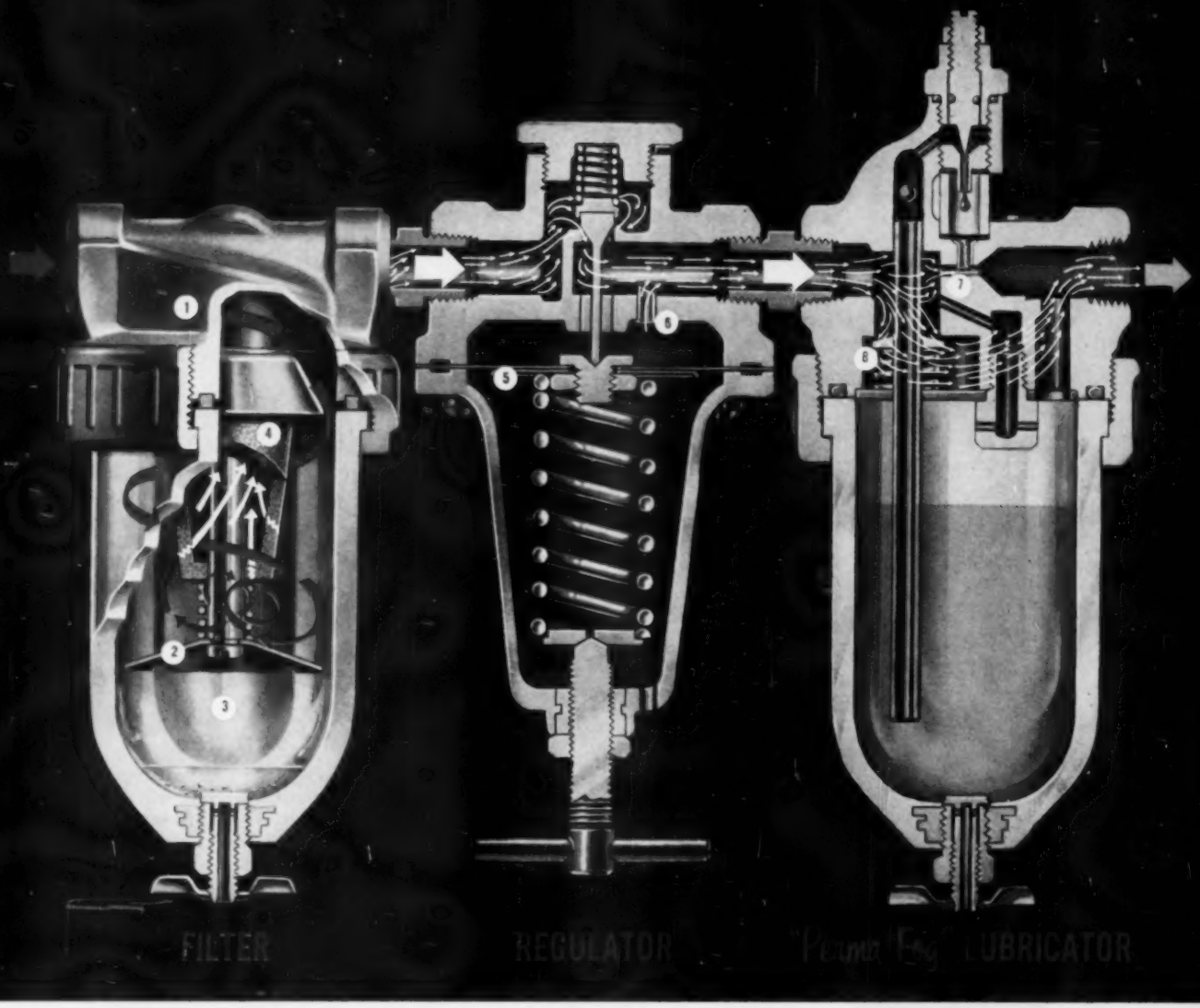
For your copy of Houghton's Packing-Fluid Compatibility Table, or for help on any hydraulic packing or fluid problem, call your Houghton representative or write: E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Houghton

INDUSTRY'S PARTNER IN PRODUCTION

Circle 85 on Reader Service Card

Circle 169 →



FILTER REGULATOR "Perma-Fog" LUBRICATOR

Curved inlet ❶ directs incoming air in downward helical pattern. Larger impurities and condensate are "thrown out" by centrifugal action, collecting on bowl sides and spiraling downward past baffle ❷ into quiet chamber for draining off. Baffle traps sediment in quiet chamber ❸ and allows only dry air centrifugally cleaned of larger impurities to reach porous bronze filter element ❹ where finer particles are filtered out.

Diaphragm of large area ❺ is of BUNA-N—imparts extra sensitivity for response to even minute reduced pressure variations. Aspirator ❻ acts directly on diaphragm, providing instant compensation for fluctuating loads . . . assures precise control and stabilizes pressures reaching individual pieces of equipment.

High velocity venturi section ❼ provides ultra-fine, enduring atomization at air flow rates even less than 1 CFM. An exclusive by-pass feature ❽ provides lubrication at high flow rate without excessive pressure drop—wide range performance in **one unit.** Proof of lubricating efficiency assured because **all** visible metered oil is atomized.

NOW! Get this efficient TRIPLE LIFE-GUARD protection for your pneumatic equipment

A continuous supply of clean dry air . . . at a constant pressure . . . with just the right amount of lubrication provided at points of friction and wear. Air-operated equipment requires this three-way protection today; the Watts combination of pneumatic controls *assures* it.

You can expect *high efficiency* from the Watts line of advanced-design air line filters, regulators, and "Perma-Fog" lubricators. It's the *quality* assembly. Specialists in protection and control devices since 1875, Watts is setting new *standards* of efficiency in pneumatic operation.

WATTS

FILTERS
REGULATORS
LUBRICATORS

YOUR SAFE PROTECTIO

Watts Regulator Company — Industrial Division — 6 Embankment Road — Lawrence, Massachusetts

SEND FOR NEW CATALOG

It's a technical bulletin as well as catalog, describing the complete line of Watts Pneumatic Products. Complete engineering and operational data is furnished so that each page is, in fact, a specification sheet. Saves valuable time for the designer.

Complete range of types—closed-center, tandem, two-position configurations, etc.

3000 p.s.i. pressure—rated pressure may be applied to all ports.

Operate solenoids without flow or pressure.

Light and compact—weighs only 5 pounds complete.

All moving parts operating in oil.

The photograph shows three Waterman Series 1617 D.C. 4-Way Solenoid Valves banked for convenient installation. Standard kits, including mounting feet, are available for banking up to seven valves; more on special order. Installation of multiple valves is greatly simplified. It is easy to add more functions later.

Send today for new Catalog 2003

W-6110R

WATERMAN HYDRAULICS CORPORATION

725 Custer Ave., Evanston, Ill.

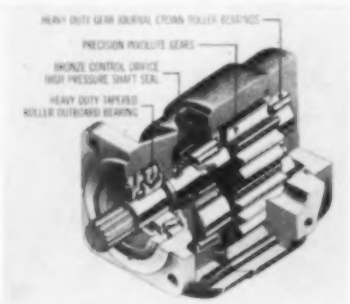
Circle **168** on Reader Service Card

NEW PRODUCTS

Circle the numbers on the Reader Service post card for more information

2500-PSI GEAR PUMP

Redesign of tooth contour of the drive and driven gears permits the pump to operate with a greater discharge per inch of gear width


HEAVY DUTY GEAR JOURNAL CROWN ROLLER BEARINGS
PRECISION INVOLUTE GEARS
BRONZE CONTROL ORIFICE
HIGH PRESSURE SHAFT SEAL
HEAVY DUTY TAPERED ROLLER OUTBOARD BEARING

than was possible in previous models. A key feature is the new extra heavy duty crown roller bearing designed specifically for this pump.

Specifications: The extra heavy-duty pump line, Model X, is available in three series with output delivery ranging from 7 to 97 gpm at 1800 rpm.—*Commercial Shearing & Stamping Co., Youngstown.*

Circle **300** on Reader Service Card

SELF-ADJUSTING ROD-WIPER

The Seal-Guard rod wiper utilizes two conical, knife-edged, flexible

bronze wiper rings, mounted in a synthetic rubber cushion ring. These flexible, oil and heat resistant wipers make positive 360-degree contact. They clean dirt from reciprocating shafts and hydraulic rods with a positive shaving action. Units are self-adjusting and easy to install.

Specifications: Available from ¼" to 6" rod diameter (standard) and up to 24½" diameter (special).—*Hydraulic Accessories Co., Warren, Mich.*

Circle **301** on Reader Service Card

LIMIT SWITCH

Heavy-duty, non-sparking aluminum cast housing with metal-to-metal seal. CW operation, CCW spring return.

Specifications: Trip differential 6 deg ±1 deg. Repetitive accuracy ±.1 deg. Safety overtravel in both directions, 45 deg. Operating force, 60 oz/in. to trip.

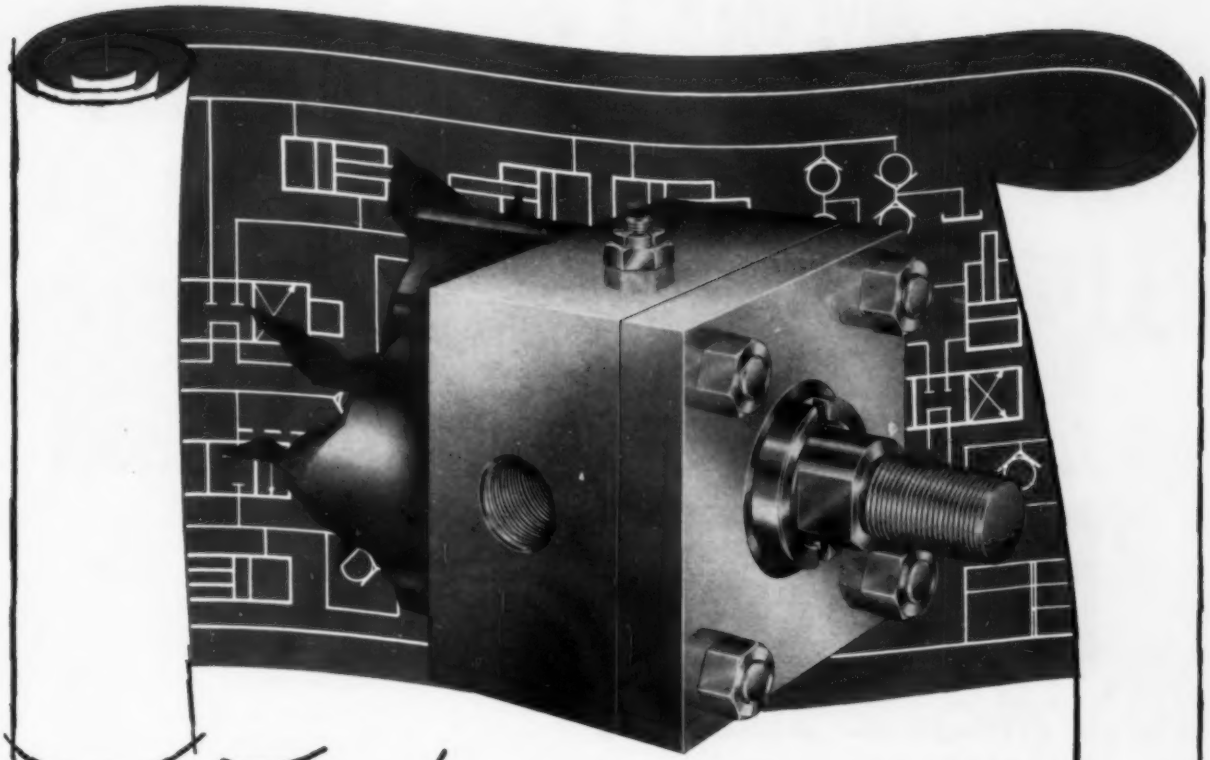
Designation: Loxswitch Model M-HL.—*R. B. Denison Mfg. Co., Bedford, Ohio.*

Circle **302** on Reader Service Card

PROTECTIVE CAPS & SLEEVES

Low cost plastic caps and sleeves made of tough, flexible polyethylene protect threaded or machined shafts and a variety of other prod-

Continued on page 58

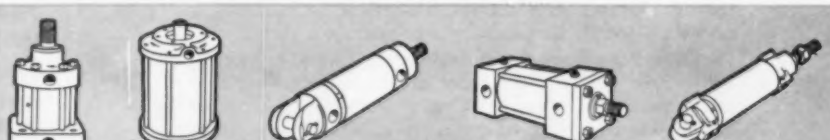


For the BLUEPRINT of your products...

SPECIFY T-J CYLINDERS . . . FOR YOUR POWER DRIVE DESIGN • APPLICATION OR REPLACEMENT MAINTENANCE

From its blueprint stage to its maintenance engineering requirement sheet, your product will assure MORE power drive precision and service, if T-J cylinders are specified. T-J's complete line too, from the Spacemaker to the new replaceable Squair Head, can be the answer to any power problem. Write or call The Tomkins-Johnson Company, 2425 W. Michigan Ave., Jackson, Michigan, today!

T-J OFFERS THE ONLY COMPLETE CYLINDER LINE



STANDARD HYDRAULIC | STANDARD PNEUMATIC | AIR and HYDRAULIC SPACEMAKER | AIR and HYDRAULIC SQUAIR HEAD | HIGH PRESSURE SPACEMAKER

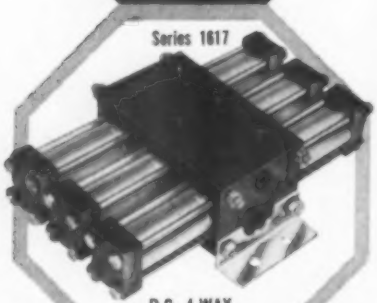
PLUS complete catalog service

T-J **TOMKINS-JOHNSON**

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

Representation in all major areas, including Canada.

WATERMAN



D.C. 4-WAY
SOLENOID VALVES

High pressure
Low leakage
No dynamic seals

Complete range of types—closed-center, tandem, two-position configurations, etc.

3000 p.s.i. pressure—rated pressure may be applied to all ports.

Operate solenoids without flow or pressure.

Light and compact—weighs only 5 pounds complete.

All moving parts operating in oil.

The photograph shows three Waterman Series 1617 D.C. 4-Way Solenoid Valves banked for convenient installation. Standard kits, including mounting feet, are available for banking up to seven valves; more on special order. Installation of multiple valves is greatly simplified. It is easy to add more functions later.

Send today for new Catalog 2003

W-6110R

WATERMAN HYDRAULICS CORPORATION

725 Custer Ave., Evanston, Ill.

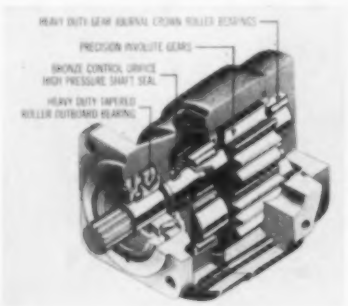
Circle **168** on Reader Service Card

NEW PRODUCTS

Circle the numbers on the Reader Service post card for more information

2500-PSI GEAR PUMP

Redesign of tooth contour of the drive and driven gears permits the pump to operate with a greater discharge per inch of gear width



than was possible in previous models. A key feature is the new extra heavy duty crown roller bearing designed specifically for this pump.

Specifications: The extra heavy-duty pump line, Model X, is available in three series with output delivery ranging from 7 to 97 gpm at 1800 rpm.—*Commercial Shearing & Stamping Co., Youngstown.*

Circle **300** on Reader Service Card

SELF-ADJUSTING ROD-WIPER

The Seal-Guard rod wiper utilizes two conical, knife-edged, flexible

bronze wiper rings, mounted in a synthetic rubber cushion ring. These flexible, oil and heat resistant wipers make positive 360-degree contact. They clean dirt from reciprocating shafts and hydraulic rods with a positive shaving action. Units are self-adjusting and easy to install.

Specifications: Available from ¾" to 6" rod diameter (standard) and up to 24½" diameter (special).—*Hydraulic Accessories Co., Warren, Mich.*

Circle **301** on Reader Service Card

LIMIT SWITCH

Heavy-duty, non-sparking aluminum cast housing with metal-to-metal seal. CW operation, CCW spring return.

Specifications: Trip differential 6 deg ±1 deg. Repetitive accuracy ±.1 deg. Safety overtravel in both directions, 45 deg. Operating force, 60 oz/in. to trip.

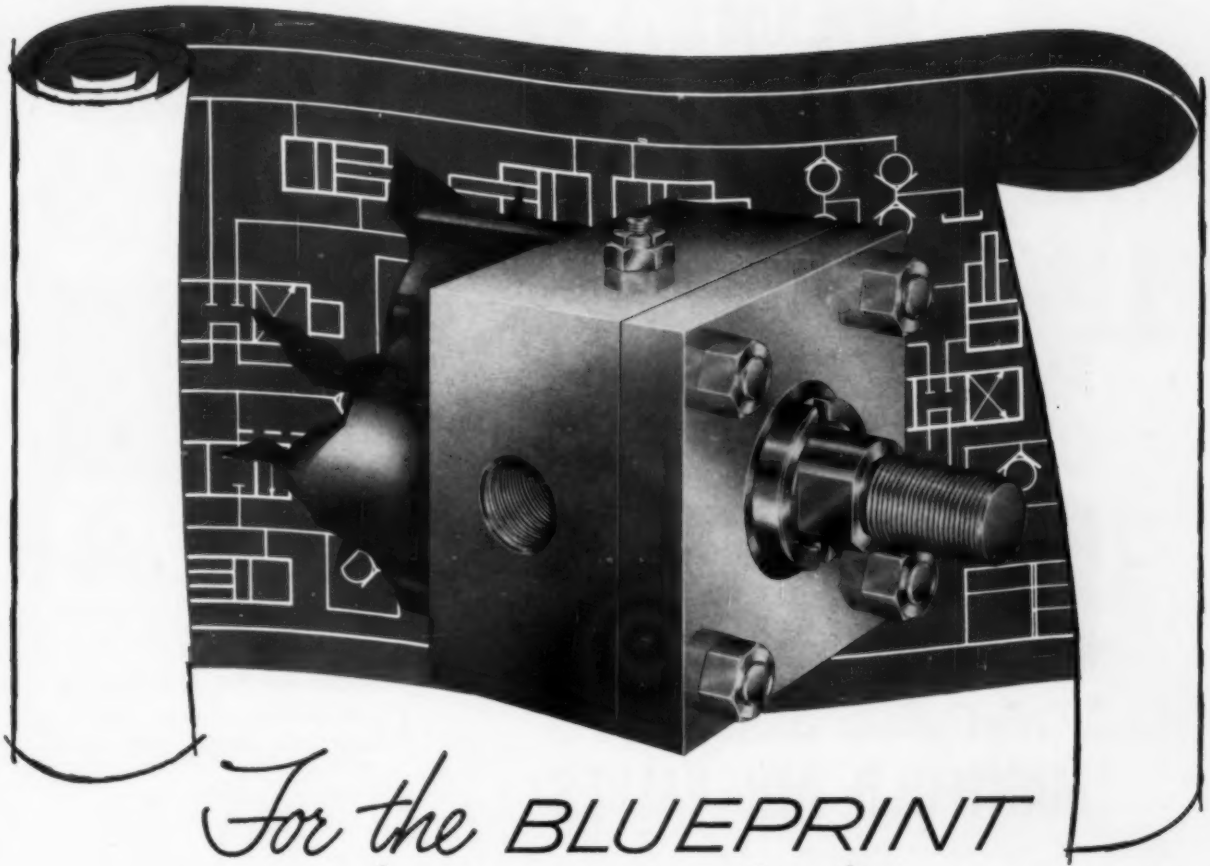
Designation: Loxswitch Model M-HL.—*R. B. Denison Mfg. Co., Bedford, Ohio.*

Circle **302** on Reader Service Card

PROTECTIVE CAPS & SLEEVES

Low cost plastic caps and sleeves made of tough, flexible polyethylene protect threaded or machined shafts and a variety of other prod-

Continued on page 58

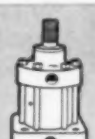


For the BLUEPRINT of your products...

SPECIFY T-J CYLINDERS . . . FOR YOUR POWER DRIVE DESIGN • APPLICATION OR REPLACEMENT MAINTENANCE

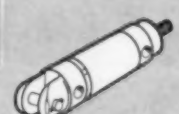
From its blueprint stage to its maintenance engineering requirement sheet, your product will assure MORE power drive precision and service, if T-J cylinders are specified. T-J's complete line too, from the Spacemaker to the new replaceable Squair Head, can be the answer to any power problem. Write or call The Tomkins-Johnson Company, 2425 W. Michigan Ave., Jackson, Michigan, today!

T-J OFFERS THE ONLY COMPLETE CYLINDER LINE

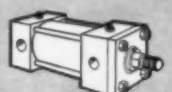


STANDARD HYDRAULIC

STANDARD PNEUMATIC



AIR and HYDRAULIC SPACEMAKER



AIR and HYDRAULIC SQUAIR HEAD

HIGH PRESSURE SPACEMAKER

PLUS complete catalog service

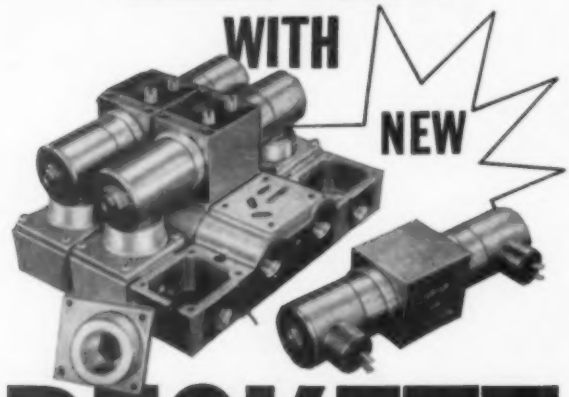
T-J **TOMKINS-JOHNSON**

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

Representation in all major areas, including Canada.

Circle **160** on Reader Service Card

SAVE ON LABOR COSTS WITH NEW



BECKETT

Hi-Cyclic STACKING MANIFOLD AIR VALVES

- Change a valve in about 2 minutes or less without disturbing piping or wiring. Remove 4 bolts and lift off valve.
- Plug-in solenoid connections—no re-wiring needed to replace a valve.
- Large manifold capacity—add valves at any time, using same air supply.
- Manifold accepts 2 or 3-position, 1/4", 3/8" and modified 1/2" sizes. 1/4" valve mounts on 2 1/8" centers; 3/8" and modified 1/2" valves mount on 2 5/8" centers.
- Wide open bus duct-type wiring area makes for easy installation of electrics.
- Built-in speed controls—with instruction plate that identifies direction for speed regulation.
- These new Beckett Hi-Cyclic Air Valves provide fast reaction for accurate control. There are no working packings—seal is by precision metal-to-metal fit. Only the stainless steel spool and brass valve body in contact with media. Seven spool types are available to meet all requirements. New Hi-Cyclic Stacking Manifold Valves will save you money on direct labor costs for installation and replacement. Write today for full details.

DISTRIBUTORS IN MAJOR CITIES
COAST-TO-COAST AND IN CANADA

NFPA MEMBER

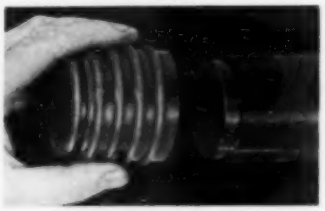
BECKETT-HARCUM CO.

981 W. LOCUST STREET, WILMINGTON, OHIO

Circle **20** on Reader Service Card

NEW PRODUCTS

ucts from damage. Relatively large or odd shape components are sealed against dust and moisture and impact. Production technique



allows protective units to be made to almost any depth in a variety of configurations.—*Caplugs Div., Protective Closures Co., Inc., Buffalo.*

Circle **303** on Reader Service Card

FLOW METER AND FILTER

Unit protects expensive machinery from costly damage. Warning light appears when liquid flow falls be-

low pre-set capacity because of filter clogging. Light turns on and power off until filter is cleaned or replaced. No by-pass is used.

Designation: Guardian.—*Capital Engrg. & Mfg. Co., Chicago.*

Circle **304** on Reader Service Card

VARIABLE VOLUME MOBILE PUMP

Variable volume piston hydraulic pump is now standard equipment for attachment on Euclid C-6 crawlers. Pump will also be used on other heavy duty equipment, rail and industrial installations, and for hydrostatic drives of self-propelled machinery. Pump has 9 pistons that rotate with cylinder block. Discharge volume is proportional to tilting of piston as-

Continued on page 62

Circle **115** →

CARTER CARBURETOR CONVERTS ALL 50 DIE-CASTING MACHINES TO PYDRAUL® A-200

Preventive maintenance with PYDRAUL

Carter Carburetor, a Division of ACF Industries, Inc., with a 10-year preventive maintenance program, *proves* economy of fire-resistant PYDRAUL in reducing downtime.

In identical die-casting machines, there were 62 pump failures per year with water-glycol fluid and *only 3* with PYDRAUL.

Carter action → 100% switch to Pydraul A-200.

COMPARE!

	PYDRAUL	Water-glycol fluid
Lubricity	Excellent	Fair
Thermal Stability	Excellent	Poor
Vapor Pressure	Very low	High
Fire Resistance	Excellent	Excellent *(provided water has not evaporated)*

Investigate how PYDRAUL can reduce *your* maintenance problems and guarantee safety in your operations. Mail the handy coupon today!

PYDRAUL safeguards production and personnel using die-casting machines • hydraulic presses • furnace tilters • mold casters • stampers • extrusion presses • ingot loaders • injection molding machines • forging presses • **Over 500 million machine-hours proves PYDRAUL performance.**

Monsanto®

Monsanto Chemical Company
Organic Chemicals Division
Industrial Fluids Dept. 4446U
St. Louis 66, Missouri

Please send me these new bulletins:
- ☐ "Know Your Fire Hazards"
- ☐ "Preventive Maintenance in Fire-Resistant Hydraulics"

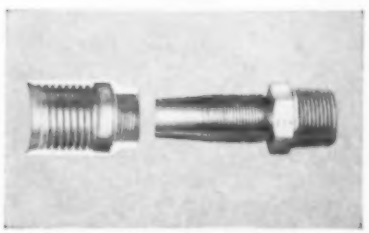
NAME.....*TITLE*.....
COMPANY.....
STREET.....
CITY.....*ZONE*.....*STATE*.....

Save Hose Replacement Dollars

Using PARKER Fittings with PARKER Hose to make Replacement Assemblies Faster

Installing Parker "Hoze-lok®" Fittings on Parker "No-Skive" Hose . . . NO SKIVING!

Installing ordinary fittings on ordinary rubber-covered hose . . . First, this messy skiving job.



Design of the "Hoze-lok" socket (left) makes the difference. The deep-tapped threads accept the **controlled thickness** rubber cover of Parker "No-Skive" Hose as they plow their way down to the wire braid of the hose. The rubber is displaced, not removed.

Just screw the hose in counter-clockwise, by hand. The rubber cover fills completely the space between each thread. It both protects and cushions the wire braid, eliminating a major cause of hose failure. A little Parker "Threadlube" is needed here.

The nipple, which is also the hose end fitting, screws in last, clockwise, in the usual way. You are now ready to make up the other end of your Parker No-Skive Hose Assembly. This method is not only faster; it gives you a better assembly. See next page.

You can install a Parker "Hoze-lok" Fitting on small-diameter Parker "No-Skive" Hose in 60 seconds. On 3/4" Parker hose, it takes 2 minutes or less. On very large sizes, allow 5 minutes per fitting. Hose replacement time is reduced to minutes the Parker No-Skive Way!

...*the* Parker No-Skive Way

Why Parker No-Skive Hose Assemblies Last Longer

BETTER PROTECTION FOR THE HOSE AT ITS POINT OF GREATEST STRESS

Most hose failures result from flexing. Ordinary hose, skived to the bare wire at the critical point where the first thread of the hose fitting bears directly on the wire braid, fails right there. As our picture shows, the leading thread of Parker "Hoze-lok" Fittings cannot reach the wire. The cushioning effect of the compressed rubber between the threads reduces the stress concentration at this point. Gripping by direct contact between the deep-tapped "Hoze-lok" threads and the wire braid occurs well within the fitting, where no flexing occurs.

Actual tests prove the effectiveness of this better design feature. Parker "Hoze-lok" assemblies on Parker "No-Skive" Hose rarely fail at the fitting, even when stressed to the burst point.

HOW PARKER DEVELOPED A BETTER HOSE TO MAKE THESE SAVINGS POSSIBLE

Parker "Hoze-lok" Fittings can be used with any hose, but you still have to skive ordinary rubber-covered hose, even with "Hoze-lok" fittings. Parker "No-Skive" Hose, however, is made to rigid specifications that limit and *control* the thickness of the cover to the exact amount of rubber that the corresponding size of "Hoze-lok" fitting will accept, when attached without skiving.

In all other characteristics, from the inner liner to the OD of the outermost wire braid, Parker "No-Skive" Hose conforms to S.A.E. specifications. In addition, because only a better grade of rubber compound can be extruded to Parker's exacting *controlled thickness* specification, the increased resistance to abrasion of the Parker "No-Skive" rubber cover results in a better hose.

ARRANGE NOW FOR A PARKER NO-SKIVE DEMONSTRATION IN YOUR OWN PLANT OR OFFICE

3079-PH

Parker FITTINGS AND HOSE DIVISION

17325 Euclid Avenue • Cleveland 12, Ohio

PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

Gentlemen: We would like to see the Parker No-Skive Way to make up replacement hose assemblies demonstrated, without any obligation on our part, of course.

Please ask your salesman or nearest "Hoze-lok" distributor to get in touch with me:

Name_____

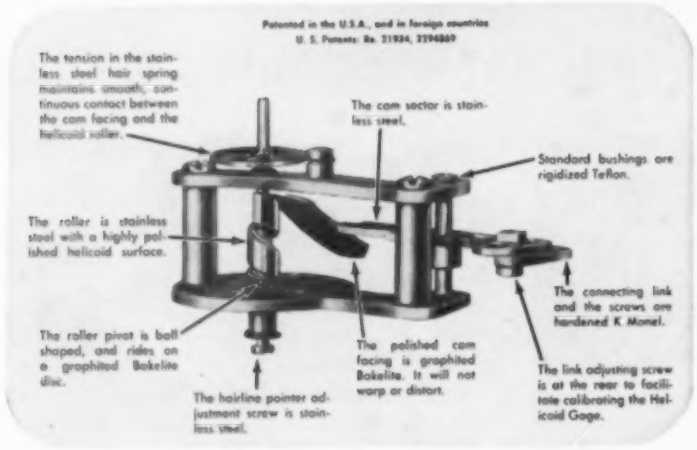
Title, Department or Division _____

Company_____

Address_____

City_____ Zone_____ State_____

We use hose for_____


Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21934, 2194869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides...
Sustained Accuracy...on the toughest jobs

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

WRITE for details

Ask for Catalog DH-65

Distributed in Canada by
Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

HELICOID GAGES

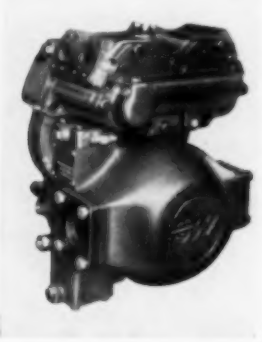
Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

ACCO

Circle **81** on Reader Service Card

NEW PRODUCTS

sembly. Pump works only on demand, and pumps only the amount of oil required to do a job. This lets equipment do more work with less hp, and reduces heat problems.



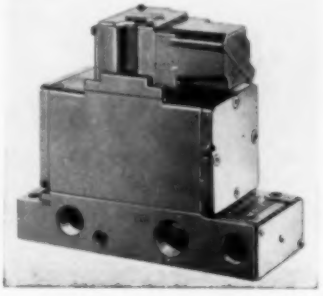
Specifications: 143 gpm at high pressure and high speed.

Designation: Variacs.—*Gar Wood Industries, Inc., Wayne, Michigan.*

Circle **305** on Reader Service Card

AIR VALVES

Series "HH", 4-way, pilot-operated, air control valves with momentary and maintained-contact electrical actuation. Maximum time required after signal to fill a 12 cu. in. load chamber from 0 to 90 psi (100



psi supply) is 0.029 seconds for the ½" valve. Time to exhaust is correspondingly fast.

Specifications: Available with plug-in type, low wattage continuously rated solenoids for most a-c and d-c ratings. Offered in ¾", ½", and ¾" pipe sizes with side ported bases standard.—*Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **306** on Reader Service Card

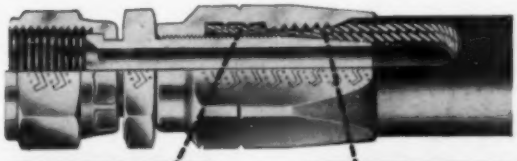
WHAT IS YOUR BEST BUY IN REUSABLE HOSE FITTINGS?

Compare

STRATOFLEX

with three other types for the answer!

STRATOFLEX "SCREW-TOGETHER" TYPE

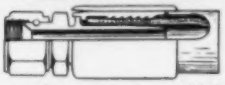


ENCLOSED PROTECTED WIRE

POSITIVE GRIP OF WIRE BRAID

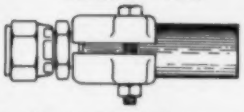
- Minimum envelope dimension
- No special tools required for assembly or disassembly
- Uses standard hose
- Complete reusability
- Pressure rating equal to burst of hose
- Uniform compression
- Long life proven in service

SLEEVE AND SEGMENTED TYPE



Wire exposed to corrosion • Limited reusability of segments • Large envelope dimension • Special tools and/or equipment required for assembly and disassembly • Non-uniform compression • Limited service history

CLAMP TYPE



Doesn't grip wire • Limited pressure rating • Large envelope dimension • Non-uniform compression • End of hose exposed to corrosion

NON-SKIVE TYPE

High assembly torques • Inconsistent grip of wire • Uses non-standard thin covered hose which has critical tolerances • Special tools required for proper assembly of hose to socket

SF5-1

STRATOFLEX Inc.

P.O. Box 10388 • Fort Worth, Texas
Branch Plants: Hawthorne, Calif., Fort Wayne, Ind.
In Canada: Stratoflex of Canada, Inc.
In Great Britain: Stratoflex (U.K.) Ltd.

SALES OFFICES:
Atlanta, Chicago
Cleveland, Dayton, Denver
Detroit, Fort Wayne
Fort Worth, Hawthorne
Houston, Kansas City
Milwaukee, New York
Orlando, Philadelphia
Pittsburgh, San Diego
San Francisco, Seattle
Toronto, Tulsa

For complete information, write for Stratoflex Catalog 201.

Circle **156** on Reader Service Card

For quiet operation...

DE LAVAL

IMO®

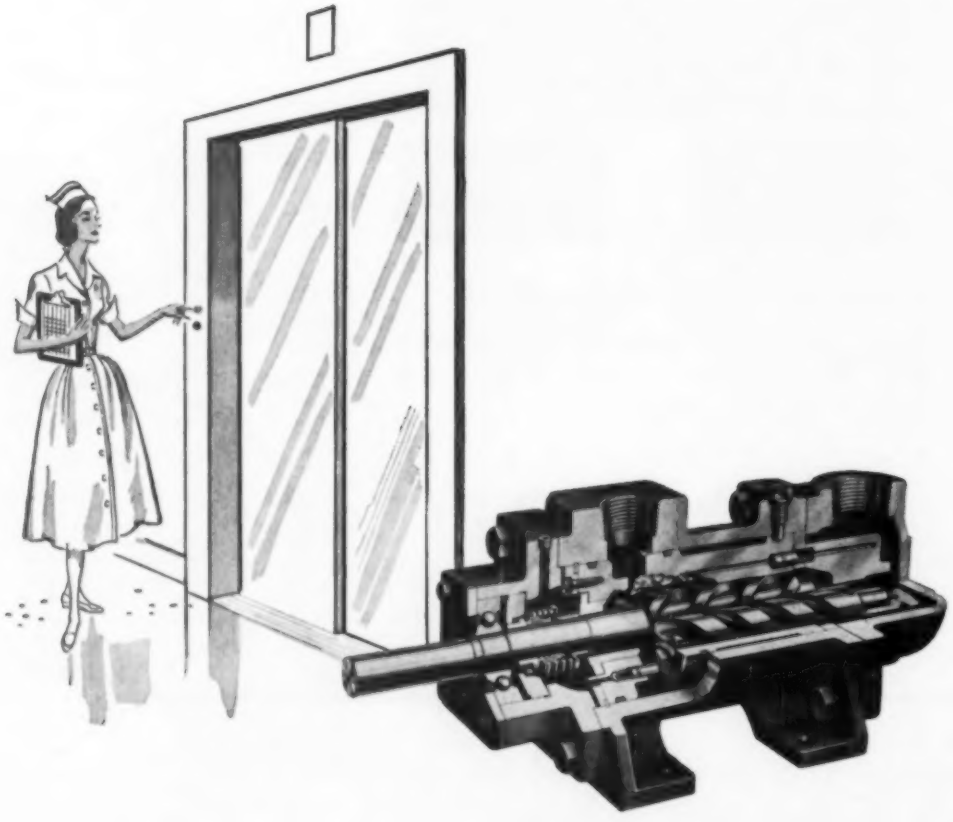
power-hydraulic pumps

The smooth rolling action of De Laval IMO pumps eliminates noise, vibration, and hydraulic whine. There are no reciprocating parts to wear and become noisy. "Hospital quiet" is assured. This is why the noise-conscious elevator industry has virtually standardized on the IMO pump for hydraulic passenger elevator installations . . . and the U. S. Navy uses IMO pumps for practically every submarine service.

Versatile IMO pumps deliver maximum profitability in many varied power-hydraulic applications. Besides quiet operation, IMO pumps offer non-pulsating flow, high speed, wide capacity range, and reliability . . . even with fire-resistant fluids. Compact design saves expensive floor space. Installed cost is lower than for other types of pumps. IMO pumps cut maintenance, too . . . only three moving parts!

For application and performance data, selection information, dimension drawings and tables, write for Bulletin IM-3200.

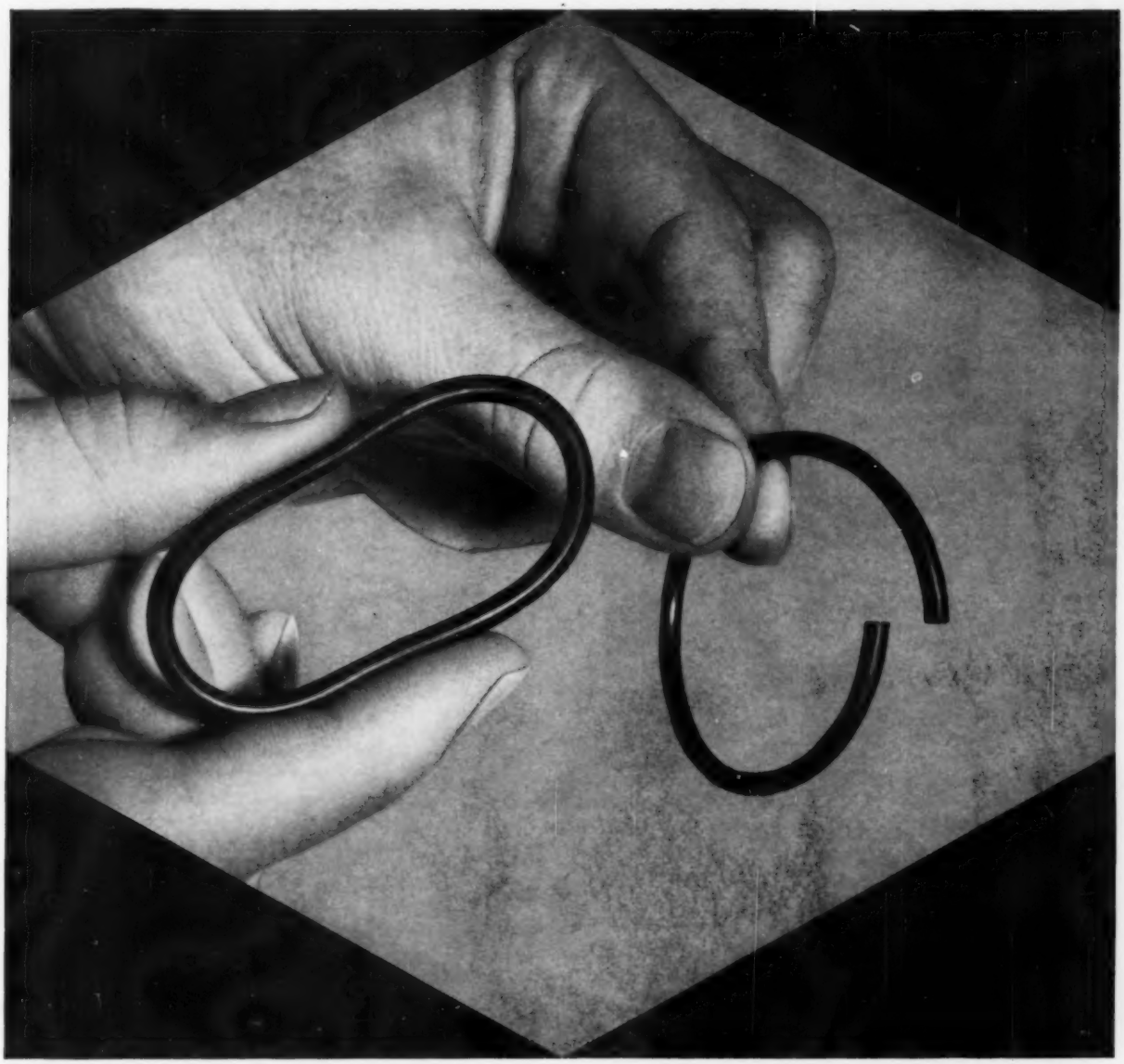
De Laval Steam Turbine Company, Trenton 2, New Jersey.



IM-DL-101

DE LAVAL • 60 YEARS OF CREATIVITY AND QUALITY

CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS



Reduce loss from leakage due to brittle seals, cut downtime needed for seal replacement. Extend the life of your Buna N and neoprene packings and seals with quality Sun Solnus oils. In a special test for oil-seal compatibility, Sunoco researchers immersed a set of O-rings in Sun Solnus oil, and a second set in another hydraulic oil, for 70 hours at 300 F each. The O-rings in the Solnus oil (*above, left*) retained their flexibility. Other rings (*right*) turned brittle as the oil robbed the rubber of its plasticizers. In addition to keeping rings flexible, Solnus oil restores flexibility to brittle rings already in service.

SUNOCO keeps seals from snapping!

SUNOCO

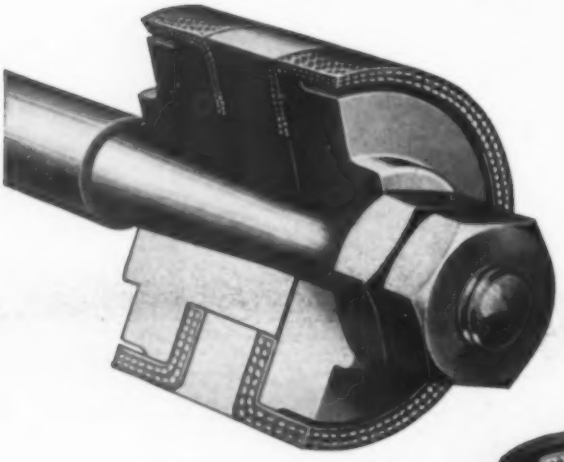
Quality . . .

THE BEST ECONOMY OF ALL

Sun Solnus oils provide the exact qualities you want in good hydraulic oils, including extended life of your packings. They're job-fitted by men who know what the job entails . . . backed by the service you have a right to expect. See your Sunoco man . . . or write to Sun Oil Company, Phila. 3, Pa., Dept. AH-9. In Canada: Sun Oil Company Limited, Toronto and Montreal.

PIONEERING PETROLEUM PROGRESS FOR 75 YEARS

LESS FLUID SLIPPAGE!
LESS DOWNTIME!
GREATER EFFICIENCY!



Darcova Pumcup

...in hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin **5908**.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA — THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

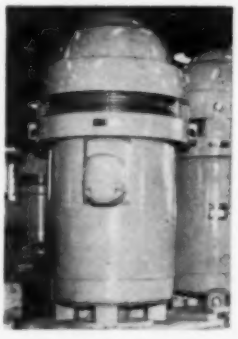
Circle **41** on Reader Service Card

NEW PRODUCTS

HOLLOW SHAFT PUMP MOTORS

Weather protection in excess of NEMA specs. Faster oil-filling, minimum spillage.

Specifications: To 800 hp. 3- or 2-phase. 60 cycle. Class A insulation 40 C. rating or Class B insulation 60 C. Speeds from 400 to



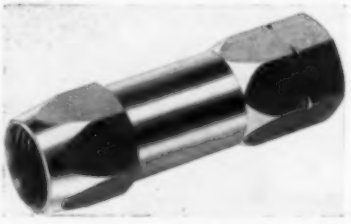
1800 rpm. Thrust capacities from 11,280 to 8,000 pounds. 220, 440, 550, and 2300 volts.

Designation: Frame 689.—*U. S. Electrical Motors Inc., Los Angeles.*

Circle **307** on Reader Service Card

SURGE-PROOF CHECK VALVE

Check valve has surge-proof operation, leak-proof check action, and low pressure drop. Surge shock is eliminated by unique hydraulic deceleration design. No gaskets.



One-piece body eliminates differential expansion and contraction.

Specifications: Operating pressure is 3000 psi and up. 10-psi pressure drop at rated flow. Temperature range —250 to 500 F. Off-the-shelf delivery in sizes ⅜" to 1".

Designation: Deccto Series.—*The Bruning Co., Lincoln, Nebraska.*

Circle **308** on Reader Service Card

PRODUCT BRIEFS

SPIRAL WRAP HOSE . . . For high-pressure, 2755 spiral wrap hose is ideal for hydraulic systems where 1¼" to 2" sizes are required at working pressures to 3000 psi. It need not be skived to attach fittings.—*Aeroquip Corp., Jackson, Mich.*

Circle **309** on Reader Service Card

AIR CYLINDERS . . . Series "C" cylinders for 200-psi. Standard strokes to 20".—*Hannifin Co., Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **310** on Reader Service Card

OIL FILTER RECLAIMER . . . Combines filter and reclaimer for removal of moisture, water, and other volatile contamination. Either section can be operated alone.—*Hilliard Corp., Elmira, N. Y.*

Circle **311** on Reader Service Card

VALVES . . . Lo-Torq valves are smaller and lighter in the 1¼" and 1½" sizes. Example: Former 130-lb valve now weighs about 50 lb; same flow characteristics.—*Republic Mfg. Co., Cleveland*

Circle **312** on Reader Service Card

BEAD CHAIN TIMER . . . Large beads in chain replace common cams in actuating switches. Wire range of timing ranges.—*Eagle Signal Co., Moline, Ill.*

Circle **313** on Reader Service Card

CENTER-HOLE TWIN CYLINDERS . . . YDT Series cylinders are available in two 1½", two 2", and two 2½" bores with capacities of 17, 30, and 50-tons at 10,000 psi.—*Precision Hydraulics Div., Owatonna Tool Co., Owatonna, Minn.*

Circle **319** on Reader Service Card

SELF-STORING AIR HOSE . . . Heavy duty Synflex self-storing air hose is for use where plant air pressure is greater than average or where mechanical stresses are extreme. After use it retracts into about 1/30th maximum working length. Hose is available in 3/16, ¼, 5/16, and ⅜" ID; lengths through 100 ft. —*Synflex Products Div., Samuel Moore & Co., Mantua, Ohio.*

Circle **320** on Reader Service Card

SNAP-ACTING, 3-WAY, PNEUMATIC VALVE . . . Mite 75, rated at 100 psig maximum, operator at 75 psig, for temperatures to 180 F. Operates within control signal range of 3 to 30 psig.—*G. W. Dahl Co. Inc., Bristol, R. I.*

Circle **321** on Reader Service Card

HIGH PRESSURE GAGE . . . The Series 6925 high pressure gage is for pneumatic or hydraulic service applications up to 10,000 psi. Overall accuracy is maintained within ±½%. Hysteresis, friction, and backlash are below readable limits. Unit contains no links, pivots, gears, hair springs, or other moving parts.—*American-Standard Controls Div., Detroit.*

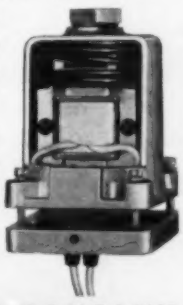
Circle **322** on Reader Service Card

COOL!

Decco OIL-IMMERSED SOLENOIDS eliminate your overheating problems.

Shock mounted in two directions, Decco Oil-Immersed Solenoids perform with unbelievable efficiency for millions of strokes with no measurable wear. Each unit is sealed in its own die-cast, oil-filled, contamination-proof housing, providing incredible heat dissipation and wear control.

Decco Oil-Immersed Solenoids incorporate all the best mechanical features of Decco Standard Solenoids. Their convenient, plug-in base allows split-second replacement in case of a change in power requirements, and they are designed to comply with J.I.C. specifications.

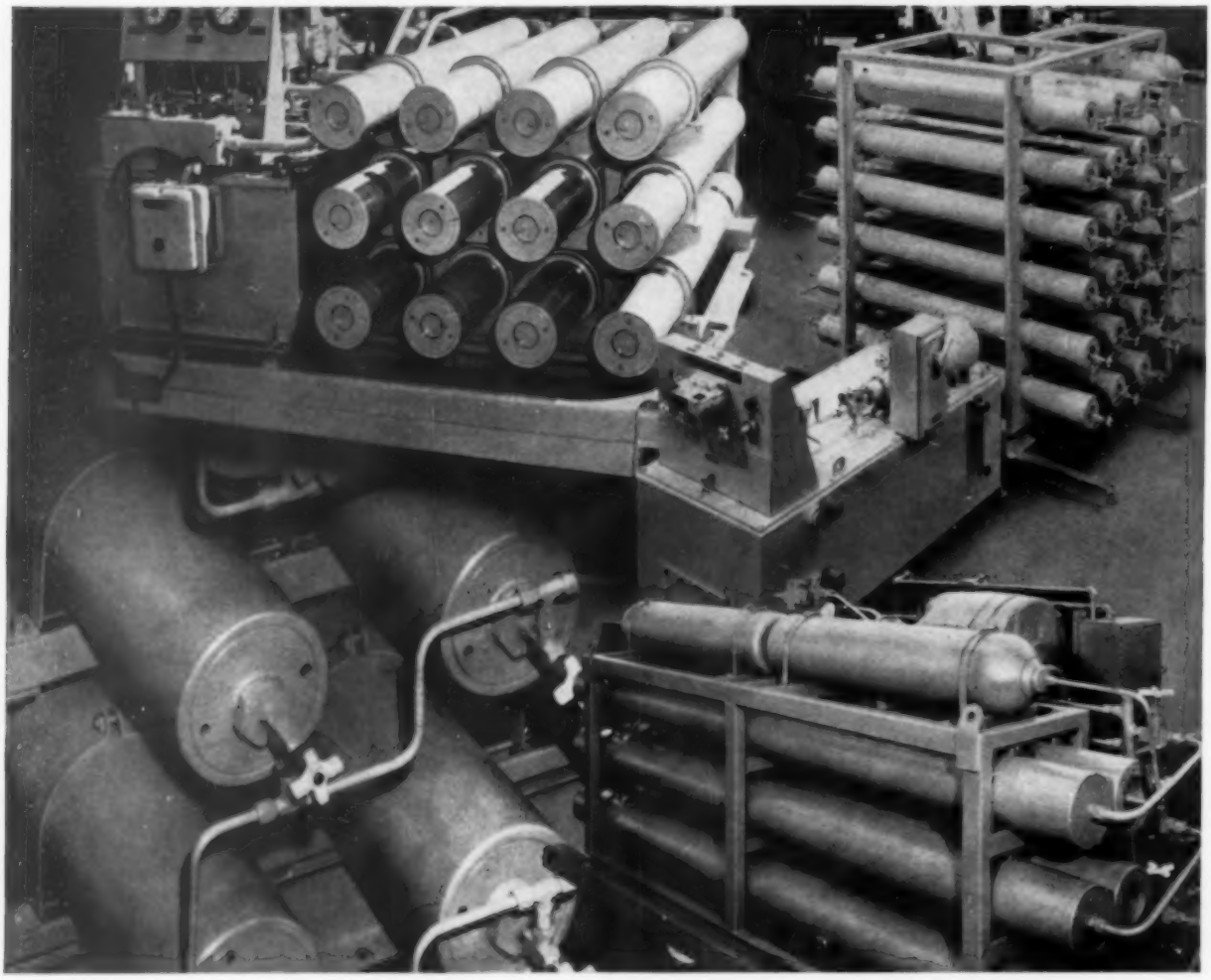


Decco Standard Solenoids are manufactured in a complete range of sizes and types. Write for complete information.

DETROIT COIL COMPANY
2435 Hilton Road • Ferndale 20, Mich.

Circle **44** on Reader Service Card

Now... more new accumulators from AMERICAN BOSCH!



AMERICAN BOSCH ACCUMULATORS are tailored to fit the job!

Now—American Bosch offers the most complete line of piston-type accumulators on the market! Sizes range from less than a quarter pint to twenty gallons. Models are available for a variety of pressures in both steel and aluminum—in many diameters, lengths and capacities to handle any job.

American Bosch accumulators are designed and manufactured to meet the most rigid requirements. They combine many features to provide the utmost in performance and reliability.

When you specify accumulators for hydraulic systems—call for AMERICAN BOSCH ACCUMULATORS! Details are included in folder AC 110-02-2. Write for a copy and the name of your nearest distributor.

AMERICAN BOSCH ARMA CORPORATION

Commercial Sales Division • Springfield, Massachusetts

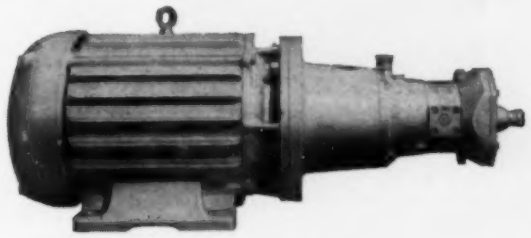
MOVE AHEAD with AB

ACCUMULATORS FOR INDUSTRIAL, MARINE AND MOBILE APPLICATIONS

6269

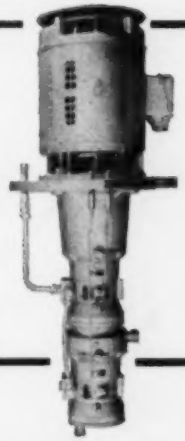
1

This is a Towler axial plunger oil pump, size A4, which discharges 14.8 cu. ins/sec. up to 5500 psi. at 1730 rpm. It can be supplied motorised as shown.



2

Two axial pumps can be mounted in tandem, one driven through the other. This example shows a motorised size A4TA4 pump fitted to a tank mounting flange, ready to drop into a tank (which is supplied if required)



3

A vane pump (L Series) is available built onto the axial pump. In this example the vane pump is fitted with a relief and unloading valve. From right to left, the combination shown here is A1CL-Motor-A4L96.

Vane pump discharges, up to 1000 psi, are 25, 41 cu. ins/sec. at 1730 rpm. and 49,77 cu. ins./sec. at 1150 rpm.

4

Towler axial pumps are available with discharges (Series A) up to 22.2 cu. ins/sec. at 5500 psi. at 1730 rpm; or (Series XA) 14.8 cu. ins./sec. at 9000 psi. 1730 rpm. They are also available for face and foot mounting, packaged in or on a tank; there is a full range of valves, and excellent high pressure system design service is available.

it all adds up to TOWLER VERSATILITY

ELECTRAULIC PUMPS CONTROLS AUTODRAULIC

TOWLER BROTHERS

(PATENTS) LTD. RODLEY, LEEDS, ENGLAND

CANADA & U.S.A.:

Walter Miller, 54 Thistledown Boulevard, Thistletown, Rexdale, Ontario, Canada
Tel. CHerry 1-9128 *Telegraphic Towlerbro Toronto Canada*

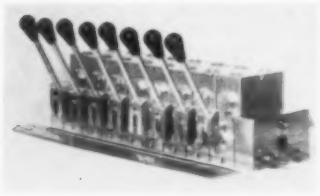
Circle 161 on Reader Service Card

NEW PRODUCTS

COMPACT VALVE BANK

Combines miniature 4-way directional control valves with gasket-mounted, double cylinder, lock valves to prevent cylinder drift by checking reverse flow. Small spool valves used as pilot valves to remotely-operated larger valves. Up to 15 directional control valves can be combined into a bank. For oils and non-corrosive fluids.

Specifications: Directional control



valves for service in systems to 3000 psi. Banks have standard ¼" and ¼" dry seal pipe threads.—*Sarasota Precision Products, Inc., Sarasota, Florida.*

Circle **314** on Reader Service Card

MANUAL DRAIN AIR FILTER

Can be cleaned without shutting off air or removing bowl. Centrifugal action spins out contaminants, throwing them to bottom of bowl. In normal operation, screw driver slot on filter element is aligned with pipe ports. To clean, element is turned 90 deg. This reverses air flow and blows off contaminants. They drop to bowl bottom and are drained manually.

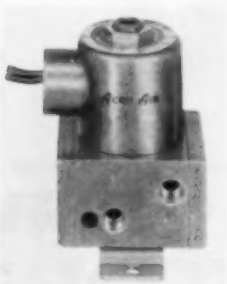
Specifications: In ¾", ½", ¾" and 1" pipe sizes.

Designation: Mark MDF.—*OEM Equipment, Cleveland.*

Circle **315** on Reader Service Card

PNEUMATIC VALVE

Model 1-J-4, a fast acting ¼" 4-way pneumatic valve, is single solenoid operated, and works with less than 10 psi in the line. It has an aluminum body and poppet-type piston



made of Buna-N bonded to stainless steel. There are no springs in the main body, and valve operates on pressures up to 150 psi.

Specifications: Valve is 3½" high by 2 5/16" square. All parts are non-corrosive. Valve can be repaired without removal from line. —*Acro Air Associates, San Leandro, Calif.*

Circle **316** on Reader Service Card

BHEW

Hydraulic Cylinders

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

THIS IS BHEW'S 1500 PSI SERIES DOUBLE-ACTING GENERAL-PURPOSE CYLINDER, designed around standard components, but custom-built to suit *your* application. Available in a variety of mountings, with or without adjustable or non-adjustable rod ends.

● Self-adjusting "V" packed rod glands ● "U" cup seal on pistons ● Honed steel barrel ● High-tensile, hard chrome plated rods ● Packings for extreme high and low temperatures, most non-flammable fluids.

Production parts save you money, do the job better! BHEW basic cylinders can easily be modified to fit your *specific* product applications. You benefit from production economies; you get custom-built cylinders.

Let's discuss your design and application problems —

FREE!
Write today for Hydraulic Cylinder Engineering Reference Data — 78 dimensional basic designs for general — and special-purpose double-acting cylinders. SAVE TIME.

BENTON HARBOR ENGINEERING WORKS, INC.
622 Langley Avenue St. Joseph, Michigan

Circle **24** on Reader Service Card

NOW, buy only the horsepower you need with REULAND'S new Hydraulic Pump Motor Intermediate* H.P. Ratings!

Tailor motor h.p. to your pump's performance curve.
Reduce motor costs... increase operating efficiency.

If you're an O.E.M. or user of hydraulic pumps, Reuland's twelve new "in-between" hydraulic pump motor ratings can start saving you money as of *today*. No longer must you pay for overmotoring... no longer must you compromise operating efficiency with an unneeded, over-size motor. *Now you pay by the horsepower... and buy only what you actually need to match the performance curve of the pump!*

Reuland's new intermediate ratings are an important sequel to *another* famous Reuland first... the original, internal spline coupling method of hooking up motor and pump!

All ratings are standard and available for quick deliveries. New price lists and engineering data sent on request. You should have a copy.

Refer to Sweet's 1961 Product Design File, 7a/RE

MODERN POWER FOR MODERN-DAY PRODUCTS

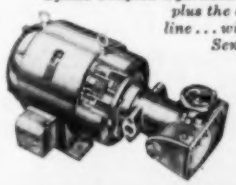
... all in lightweight, cool-running aluminum frames!

28 horsepower ratings from ½ through 60... 12 brand new, exclusive, intermediate ratings!

½	¾	1	1½	2	2½*	3
4*	5	6¼*	7½	8¾*	10	12½*
15	17½*	20	22½*	25	27½*	30
32½*	35*	37½*	40	45*	50	60

*Exclusive, new intermediate ratings.

Your copy of this catalog on Reuland Spline Coupled Hydraulic Pump Motors... plus the complete Reuland line... will come in handy. Sent free on request.



REULAND MOTORS

REULAND ELECTRIC COMPANY
Western Division: Alhambra, California
Eastern Division: Howell, Michigan
Distributors in all principal cities

Circle **141** on Reader Service Card

IN ANY CLIMATIC CONDITION

formrite

HOSE-TO-TUBE ASSEMBLIES retain their flexibility

Formrite Hose-to-Tube Assemblies are widely used on hydraulically operated equipment as flexible fluid transfer connections. Capable of withstanding high operating pressure under arctic and equatorial temperature extremes, the rugged, flexible Formrite hose is available in lengths up to 50 feet. Hose construction is such that it effectively resists the deteriorating qualities associated with hydraulic fluids. Assemblies can be specified in one or two wire braid.

- QUICK INSTALLATION
- STREAMLINED DESIGN
- LOWER FIRST COST
- SMART APPEARANCE

Formrite hose assembly with "O" ring flange for easy mounting.

Formrite hose assembly with lock-wire swivel and "O" ring.

Formrite hose assembly with Male or Female threads.

Specialists in the design and fabrication of precision formed metal tubes for fluid transfer lines, Formrite also has complete lines of tube fittings in a wide range of shapes and sizes. Forgings, castings and flange mounted fittings are available in addition, and can be machined to exacting requirements.

write on your letterhead for FREE HOSE SECTION CATALOG to . . .

formrite TUBE COMPANY

TUBE COMPANY
TWO RIVERS, WISCONSIN
MEDINA, OHIO

Circle **58** on Reader Service Card

NEW PRODUCTS

VALVE-IN-HEAD CYLINDERS

Interchangeable add-a-mount, foot, clevis, and front or rear flange mounts. Two styles of interchangeable rod glands, standard flush nose for flush mountings or threaded nose for stud mountings.

Valve-in-head cylinders have full-flow orifices and can be used for oil or water. Special seals available for fire-resistant fluids.

Specifications: For air, oil, or water. Pressures: Air to 200 psi, oil and water to 500 psi. Available in most bore sizes.—*Superior Controls, Div. Superior Screw & Mfg. Co., Inc., Crystal Lake, Ill.*

Circle **317** on Reader Service Card

DUAL-PURPOSE VALVE

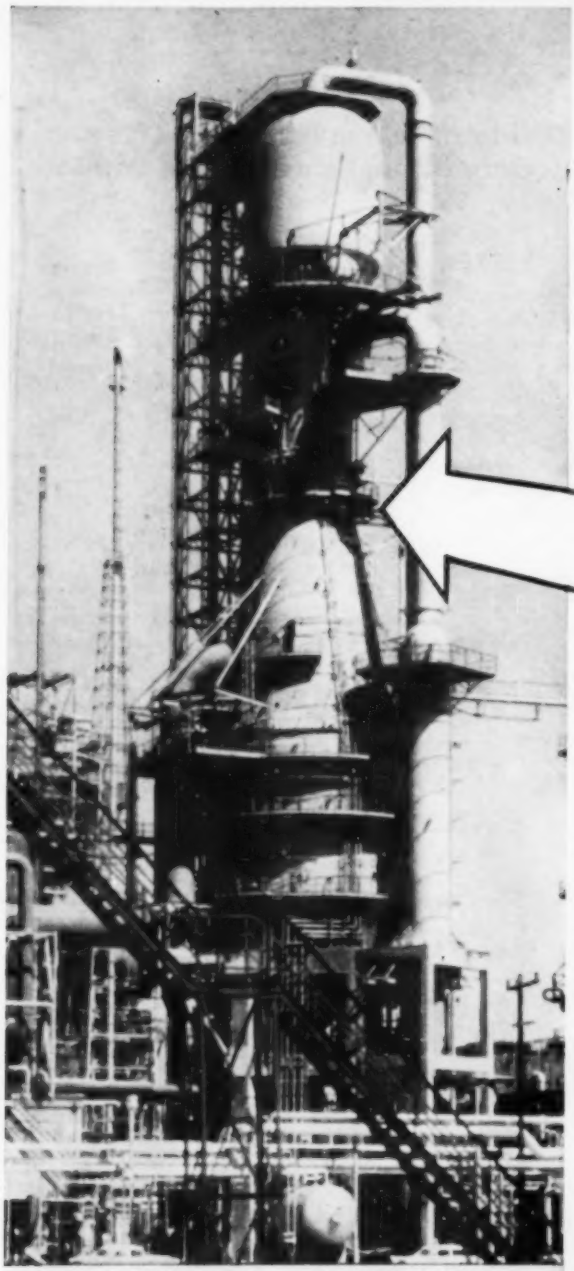
A single, compact valve serves as a quick exhaust or a double check valve for pneumatic service. Used for quick-exhaust, it can be mounted on or near the cylinder port. When pressure from the control valve is released, the valve dumps exhaust air from the cylinder to atmosphere. As a double-check or shuttle valve, it connects two independent air supply or control lines to a common line.

Specifications: The aluminum bodied valve operates to 200 psi, is 1¾" diameter, 2½" long, with three ⅜" NPT female ports.—*Modernair Corp., San Leandro, Calif.*

Circle **318** on Reader Service Card

For more NEW PRODUCT reviews turn to page 150

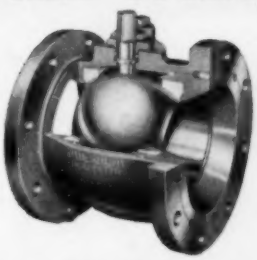
At *CRITICAL* Valve Control Points



...You Get Dependable Operation with

jamesbury "Double-Seal"™ BALL VALVES*

*PATENTED



WIDE RANGE OF SIZES:

Screwed end ¼" through 3".

Flanged 150# series ½" through 12" — 300# ½" through 8".

Larger sizes on request.

VARIETY OF MATERIALS:

Valves in 303 and 316 Stainless Steel, Alloy 20, Carbon Steel, Bronze, Ductile Iron, Monel, Aluminum and PVC. Interchangeable seats and seals in Teflon, Teflon compounds, Nylon, Buna-N, Neoprene, Hypalon and natural rubbers. Type DZ: Ductile Iron and Carbon Steel, Standard.
Other materials on request.

FIRE SAFE VALVING IN REFINERIES

The Jamesbury "Double-Seal" FIRE SAFE Ball Valve (Type DZ) has been accepted for use in the hydrocarbon industry because of its outstanding performance. In the event of fire — and the loss of the valve's soft seats, secondary metal seats provide effective shut-off of the fluid flow.

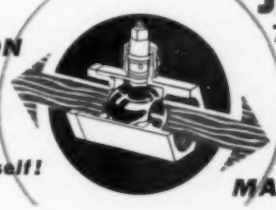
It stands to reason that a valve that performs outstandingly under adverse conditions can be relied on to give trouble-free performance under less severe conditions. That has been one of the big reasons, at least, for the success of Jamesbury "Double-Seal" Ball Valves. Proved dependable at *critical* valve control points, these valves have gone into industrial plants everywhere to control nearly all types of media flow.

There are many exclusive features about the Jamesbury "Double-Seal" Ball Valve which contribute to its excellent performance record. For example, there's Jamesbury's patented lip seal; there are no internal springs; you get leak-tight stem seals; operators are mounted integral with the valve. For further information about Jamesbury "Double-Seal" Ball Valves, contact your nearest stocking distributor — or write us direct.

Ask For Jamesbury Fluid Services Guide

JAMESBURY CORP.
72 New Street, Worcester, Mass.
DISTRIBUTORS IN PRINCIPAL CITIES

QUARTER TURN OPERATION
HIGH FLOW CAPACITY
ZERO LEAKAGE



NO LUBRICATION REQUIRED
MINIMUM MAINTENANCE
MANUAL OR POWER OPERATION

As Versatile As Industry Itself!

174-1 ©Jamesbury Corp. 1961

VOTE HERE

what use can you make of this

DIAPHRAGM VALVE?

Check one or more of the following

- ☐ As a power-operated line valve of any kind, normally-open or normally-closed, with better-than-average low pressure-loss and high flow-rate characteristics.
- ☐ As a remotely-operated flow-control valve in an inaccessible location where reliability and long life are important.
- ☐ As automatically-controlled units in a complexity of flow circuits, where rapid and certain response to control signals is significant.
- ☐ As a large power-operated control valve where the actuating power is the actual line pressure, and release is accomplished by simply bleeding this pressure to drain with a small solenoid, pneumatic, or manual valve.

INSTRUCTIONS

1. After "voting," write your name, company, and address in the margin.
2. Tear out this page and mail to:

AquaMatic INC.

2404 GRANT AVE., ROCKFORD, ILLINOIS

ENGINEERED WATER AquaMatic CONDITIONING CONTROLS

Circle **13** on Reader Service Card

NEW LITERATURE

Circle the numbers on the Reader Service post card for free copies

MAGNETIC TANK TRAPPER

Keeps hydraulic reservoirs free of metal chips. Heavy duty mounting with 5¾" long support rod, ⅝"-18 thread on outboard end. 2", 2½", and 3" NPT pipe plugs drilled and tapped ⅝-18 to fit support rod are optional. 3" or 2½" plugs recommended. Bulletin gives sizes, illustrates individual parts. For 350-gal reservoir. Can provide greater capacity units on request.—*Kebby Co., Rockford, Ill.*

Circle **400** on Reader Service Card

HEAT EXCHANGERS

"Pre-engineered" shell and tube heat exchangers using standardized components are described. They are available in 3 standard tube lengths; 25 shell diameters; 2, 4, or 6 tubeside; and 150, 300, and 450 lb tubeside and shellside pressures. Catalog contains complete engineering data including design and construction details, setting plans, stacking dimensions, tube counts, and surface areas. (101)—*Griscom-Russell Co., Massilon, Ohio.*

Circle **401** on Reader Service Card

FILTERED FIXED RESISTORS

This brochure covers "Lee Jets", a means to restrict and regulate fluid flow. Each jet contains a calibrated orifice, two matched filters (for flow in either direction), and a locking and sealing device. Easy installation eliminates costly assemblies, seals, threads, flow testing, and filter design.—*Lee Co., Westbrook, Conn.*

Circle **402** on Reader Service Card

AIR LINE CONTROLS

Complete line of pneumatic products covered in 64-page catalog, No. 1000. Describes compressed air filters, pressure regulators, air-line lubricators, valves, and accessories. Section devoted to engineering information includes compressed air flow chart, moisture content of saturated, compressed air, dimensional data.—*C. A. Norgren Co., Englewood, Colorado.*

Circle **403** on Reader Service Card

DRY AIR SYSTEMS

Described in this brochure is a system that economically chills (40 F or lower), dries, cleans, and forces air or gases into compressor intakes. Large amounts of usable cold water are removed before compression, resulting in increased delivered air volume and virtually eliminating oil/water sludge and water vapor corrosion. —*Lynch Corp., Glass Machinery Div., Anderson, Ind.*

Circle **404** on Reader Service Card

TEFLON LINED RUBBER TUBING

Described is tubing for applications where protection to Teflon is required to prevent kinking or abraiding in service. Teflon liner is available in ¼" through 1" ID covered with Neoprene or other elastomers; available in lengths to meet customer specifications. (1-RR)—*Pennsylvania Fluorocarbon Co., Philadelphia.*

Circle **405** on Reader Service Card

ALTERNATING CURRENT TRANSDUCERS

Linear dispalcement transducers for a-c system operation. An introduction to the company's linear motion transducer is given and configurations of some 300 proven designs are shown. Many of these items are in stock and can be readily supplied with minor variations.—*G. L. Collins Corp., Long Beach, Calif.*

Circle **406** on Reader Service Card

Circle **102** →

"OFF-THE-SHELF" VERSATILITY*

LEAR-ROMEC
GEAR PUMPS AND MOTORS
RELIABILITY PROVEN
THROUGH 1,000,000
CYCLES OF TESTING

Now you can "engineer"* your own...

LEAR HYDRAULIC PUMPS & MOTORS

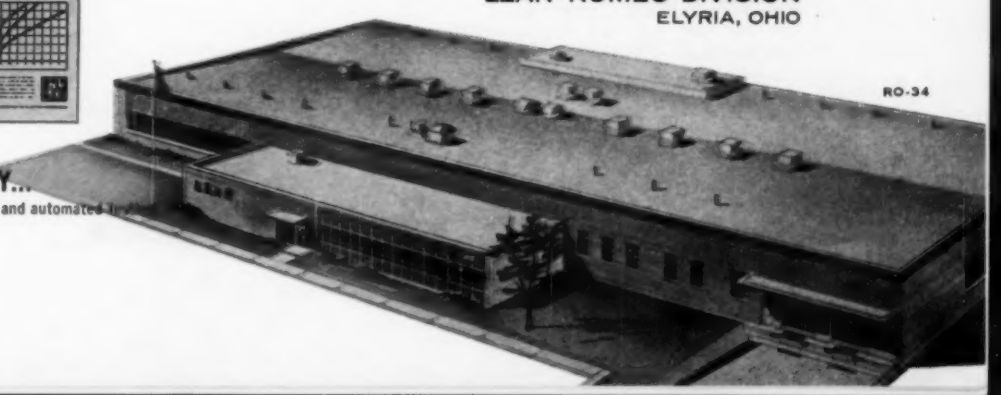
***INTERCHANGEABLE "OFF-THE-SHELF" COMPONENTS PROVIDE MULTIPLE COMBINATIONS TO MEET THE REQUIREMENTS OF A WIDE RANGE OF APPLICATIONS**

- 2 to 100 gpm pump flow
- 1 to 9 cu. in. motor displacement
- to 2500 psi pressure continuous
- foot or flange mounted
- side or end ports
- any type of drive shaft
- CW or CCW rotation

WRITE OR TELEPHONE
FOR DETAILED
TECHNICAL INFORMATION

New design flexibility provides immediate "off-the-shelf" delivery. Allows you to "engineer" the pump and motor to fit *your* special mobile equipment requirements. For any capacity unit, simply choose the mounting, drive shaft, porting, bearings, rotation, and mounting flanges. These rugged, all-aluminum pumps have only nine principal parts – the motor only twelve. This simplicity of design, mass production, and precise automated testing, means longer service life – increased reliability – lower initial cost. Consult Lear-Romec for engineering details and specifications to *"engineer" your own* economical and efficient hydraulic pumps and motors.

LEAR
LEAR-ROMEC DIVISION
ELYRIA, OHIO



RO-34

NEW PRODUCTION FACILITY...
tooled with the latest production machinery and automated l...

NEW LITERATURE

INDUSTRIAL COMPRESSORS

Unit type compressors from ½ to 15 hp for displacements up to 70 cfm are described with stationary models from 25 to 100 hp for industrial air supply. Also shown are compressors in three sizes from 80 to 250 psi with single or two-stage operation. Stationary compressors with ratings of 25, 50, 75, and 100 hp supply air at 125 psi in one and two stage compression cycles.—*Le Roi Div., Westinghouse Air Brake Co., Sidney, Ohio.*

Circle **407** on Reader Service Card

SELF-SEALING COUPLINGS

A handy, 20-page booklet provides a general discussion of the basic applications possible with self-sealing couplings. It is well illustrated and is prepared to acquaint the engineer or technician with general information rather than specific details. For example, a section explains how these units can replace two shut-off valves to maintain pressure in a hydraulic system or prevent fluid drainage from the system. (629)—*Aeroquip Corp., Jackson, Mich.*

Circle **408** on Reader Service Card

HYDRAULIC CONTROL ROD DRIVE FOR N. S. SAVANNAH

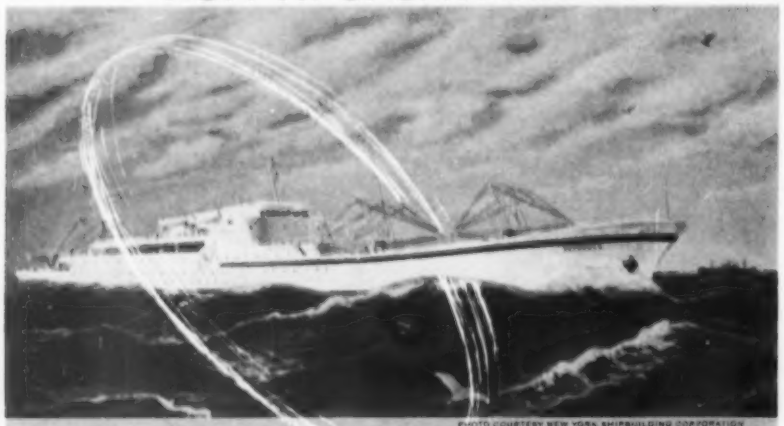


PHOTO COURTESY NEW YORK SHIPBUILDING CORPORATION

DESIGNED AND MANUFACTURED BY RUCKER

The Rucker Scram and Monitoring system maintains an even balance of the N. S. Savannah's reactor, reduces load on the drive mechanism system, assures instantaneous shutdown, and automatically activates reserve power systems.

The Rucker Company offers unparalleled experience in the design and manufacture of electro-hydraulically actuated reactor control rod drive systems for extreme reliability, unequalled response time achievements of 25 milliseconds and less, stored energy, minimum maintenance in hot areas, and positive monitoring from remote locations.

When your problem involves fluidynamic power, you can rely on Rucker . . . a leader in hydraulics and in power and control systems since 1941.

THE RUCKER COMPANY
4700 San Pablo Avenue • OLympic 3-5221 • Oakland 8, California
LOS ANGELES • OAKLAND • PORTLAND • SEATTLE

Other Shim and Scram Systems built by Rucker for Hanford and Indian Point

Circle **145** on Reader Service Card

DIAPHRAGM VALVES

Normally-open and normally-closed valves are described. Features of operation are discussed and illustrated by cut-away and line drawings. Charts and tables list flow rates and dimensions. Screw type connections only. (800A)—*AquaMatic Inc., Rockford, Ill.*

Circle **409** on Reader Service Card

HOSE & COUPLINGS

Dimensions and specifications of standard lines of industrial and automotive hose, hose couplings, union adapters, and connectors. Detailed drawings and cut-away photographs are included. (61-A)—*American Coupling Corp., Warren, Mich.*

Circle **410** on Reader Service Card

PACKINGS

A revised edition of this company's product brochure on Lattice Braid packings updates technical data. It also contains information on new Style 5875 packing made from long fiber asbestos yarn with Teflon impregnation. (AD-131)—*Garlock Inc., Palmyra, N.Y.*

Circle **411** on Reader Service Card

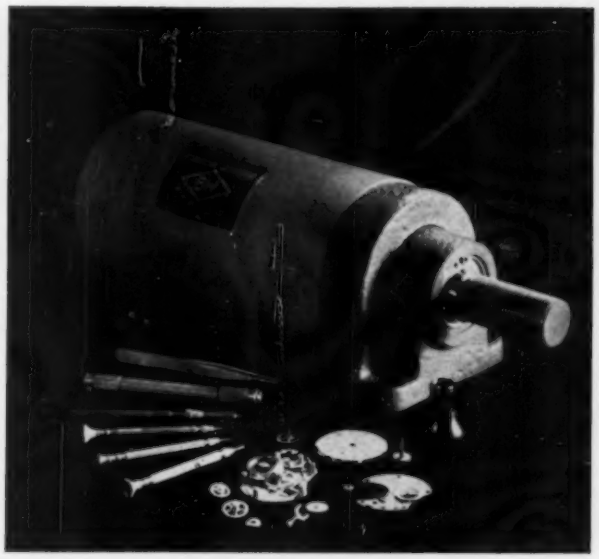
POWER UNIT ACCESSORIES

Catalog illustrates and describes complete line of JIC reservoirs, oil level sight gages, and hydraulic power unit accessories. Each reservoir from 10 gal. to 250 gal. is completely dimensioned.—*Century Hydraulics, Div. Century-Detroit, Detroit.*

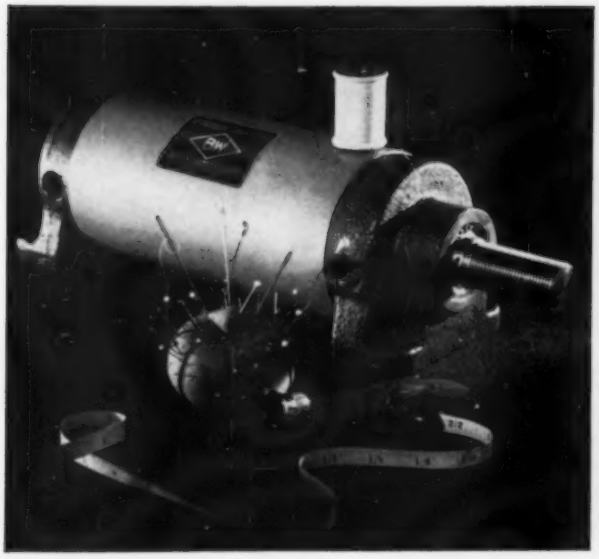
Circle **412** on Reader Service Card

For more reviews of FREE LITERATURE turn to page 166

DEPENDABLE NAME, DEPENDABLE PRODUCT



QUALITY MATERIALS AND CRAFTSMANSHIP



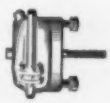
TAILORED TO FIT YOUR NEEDS

FAST, DEPENDABLE DELIVERIES

All yours with Bendix-Westinghouse Power Cylinders

Dependability . . . quality . . . specialized engineering . . . quick delivery. If you're seeking these features in power cylinders, your best source is Bendix-Westinghouse. Our experience has been earned in nearly every imaginable application—light, medium and heavy-duty—standard and special—involving pressures up to 200 psi air and 1800 psi oil on standard models, higher on specials. We maintain a large inventory of machined parts for standard units, and offer the flexibility to "tailor" power cylinder sizes and mounting arrangements to your needs quickly and accurately. Write or call for complete information on industrial product applications involving power cylinders from Bendix-Westinghouse.

ROTOCHAMBER has neoprene diaphragm, delivers from 900 to 5000 pounds force at 100 psi air pressure.



ROBOTAIR CHAMBER has optional rubber or neoprene diaphragm, delivers from 300 to 3600 pounds force at 100 psi air pressure.

Bendix-Westinghouse BW®

INDUSTRIAL PRODUCTS

Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio

Circle **23** on Reader Service Card

Fulflo

Honan-Crane

Delpark

Michiana

YOUR BEST CHOICE IN FILTERS FOR ALL HYDRAULIC AND AIR-OPERATED EQUIPMENT

CFC Hydraulic Fluid Filters have been designed and installed on equipment that ranges all the way from a small plastic extruder to the hydraulic system in a missile silo. CFC Pneumatic Filters vary from a single tube high pressure unit on the nuclear-powered "George Washington" to a 50,000 CFM unit for a jet engine test stand.

CFC Filters are the choice of industry because they have been proven under critical operating conditions, because CFC has 25 years of specialized design engineering experience to rely on . . . in short because engineers can be sure that a CFC filter is the best filter available, at lowest cost.

CFC

COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

Hallprene MOULDED SEALS AND DIAPHRAGMS

"Hallprene" Synthetic Rubbers impregnated into cotton, nylon or asbestos fabrics, are used to make moulded seals and diaphragms of exceptional strength and stability.

Heat, oil and petrol resistant
Sunlight and ozone resistant
Low temperature flexibility
Low compression set

HALL & HALL LIMITED
OLDFIELD WORKS HAMPTON MIDDLESEX ENGLAND
Tel: Molesey 2180
In Scotland · Wilson Place · East Kilbride · Glasgow
Tel: East Kilbride 20581

Represented in Canada by:
Mr. P. J. O'HIGGINS,
3825 FINCH AVENUE EAST
AGINCOURT, ONT.

Circle **73** on Reader Service Card

AT LAST! 12 YEARS OF RESEARCH MAKES PRESENT...

PNEUMATIC COUPLINGS OBSOLETE

YOU NEED THE

DYNA-CON

IT'S A COUPLING! IT'S A VALVE!
AT THE PRICE OF A COUPLING ALONE!

HIGHEST CAPACITY

You get up to 30% greater capacity because there are *no conventional valve components* such as springs, washers, etc, to block the free flow of air.

EASIEST TO CONNECT

No line pressure or valve spring resistance to overcome in the coupling operation. For the first time, no strength is required in any coupling situation.

SAFEST BY FAR

No line pressure to blow the plug out when uncoupling. Furthermore the exclusive new concept in design makes *accidental uncoupling impossible.*

MOST ECONOMICAL

Highest air-flow capacity makes it possible for you to *use smaller* DYNA-CON sizes compared to present, over-sized, low-capacity couplings.

The DYNA-CON works as a coupling and as a 3-way valve . . . for the price of a coupling alone.

dyna-quip®

A DIVISION OF STILE CRAFT MANUFACTURERS INC.

Since 1936

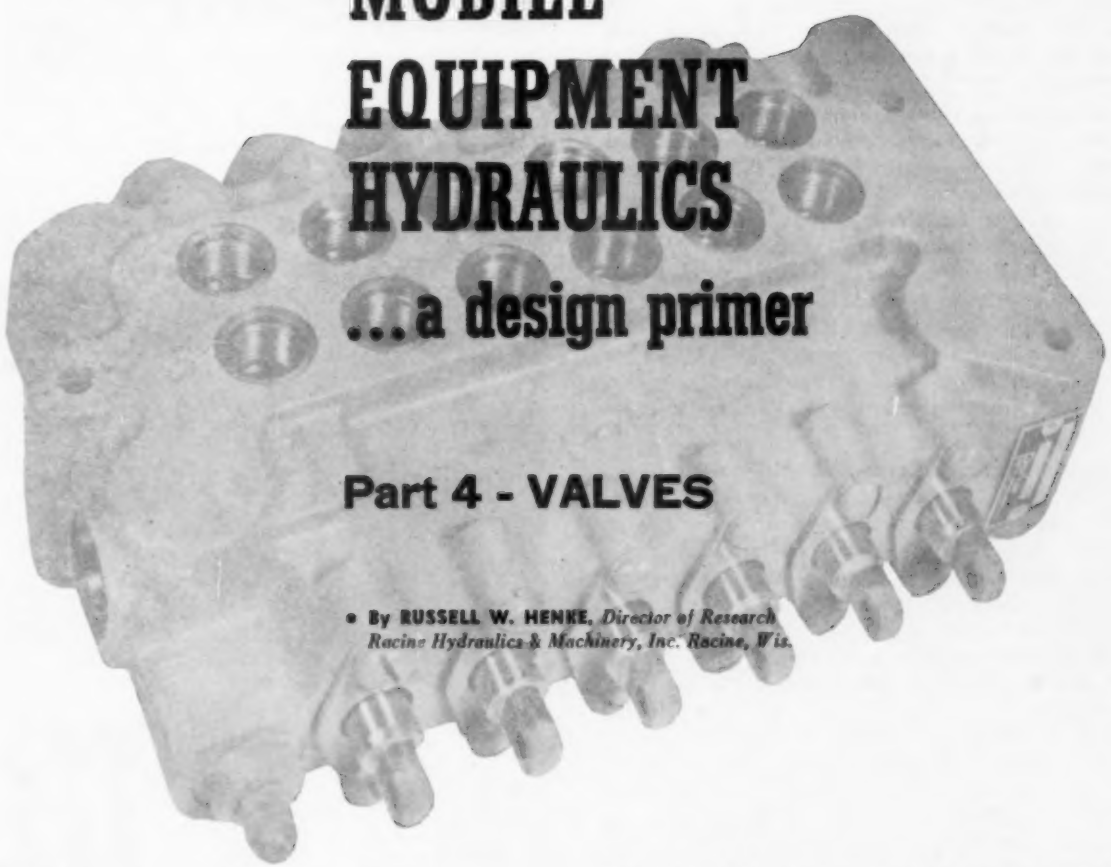
1825 MACKLIND AVE. ST. LOUIS 10, MO.

Hydraulics & Pneumatics
SEPTEMBER 1961

MOBILE EQUIPMENT HYDRAULICS ...a design primer

Part 4 - VALVES

• By **RUSSELL W. HENKE**, *Director of Research*
Racine Hydraulics & Machinery, Inc. Racine, Wis.



Mobile equipment places severe demands on hydraulic valves. They must be rugged, have good metering characteristics, be versatile, and require a minimum of service. Mobile equipment circuits seldom require the precise fixed flows or repetitive cycling of machine tools. However, they do require accurate metering to give the operator maximum control over the machine's functions.

RECENT TRENDS toward better filtration in mobile hydraulic systems has given valve manufacturers a greater freedom in design. Valve efficiency and accuracy can be improved by reducing clearances, providing the valves operate in a clean system.

All mobile equipment circuits use directional control valves and relief valves. Flow control valves are used only when regulating cylinder or fluid motor speed such as controlling the lift cylinder lowering speed on a fork lift truck.

A bypass flow regulator is used in circuits where power steering or power brakes are supplied with fluid from the same pump furnishing fluid for load manipulation. This valve, sometimes called a flow divider, diverts a set portion of pump output to the steering or brake circuit and bypasses the remainder to the load manipulating circuit.

• **Directional Control Valves**—These differ considerably from industrial valves. The industrial terms, open-center, closed-center, and tandem-center are replaced with series, parallel, and series/parallel. (See symbol drawings and explanation below.) Most mobile hydraulic circuits control more than one cylinder or fluid motor. For this reason directional control valves for mobile equipment are generally in banks or stacks. There may be a number of valves in one body, or a valve stack may be made up of individual valve sections held together with tierods.

A valve bank or stack may be made up of both single and double-acting valves, if the equipment requires both.

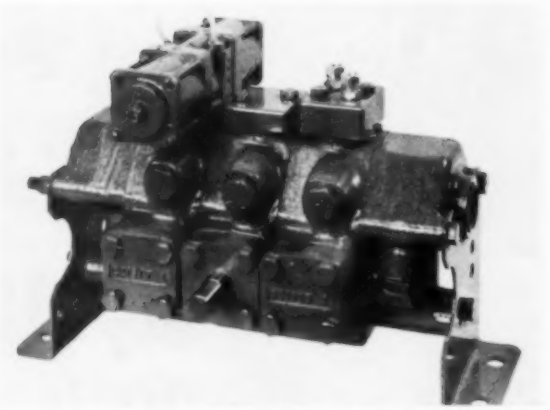
• **Single-acting valves**—Flow through single-acting, mobile equipment valves differs from most industrial 3-way valves. In industrial valves, pump flow is usually blocked in one of the valve's two positions. Mobile single-acting valves generally have 3 positions. In the center or neutral position, pump flow passes through the valve to tank or to additional valves downstream; the cylinder port is blocked. In one extreme position pump flow is directed to the cylinder, and in the other extreme position the cylinder is connected to tank. This valve is used for raising cylinders that lower from their own weight or the weight of the load they support.

• **Double-acting Valves**—Often the graphical symbol for a single, directional control valve for mobile equipment gives the appearance of an entire circuit, complete with relief valves, check valves, and restrictor valves. There may be 3, 4, or 5 working positions, each providing a different function.

Three position valves are generally spring-centered. In their center position, pump output flows through the valve to tank or to additional valves in the bank. This is true in parallel, series, and series/parallel valves. Variations in internal portings give mobile double-acting valves versatility in controlling flow.

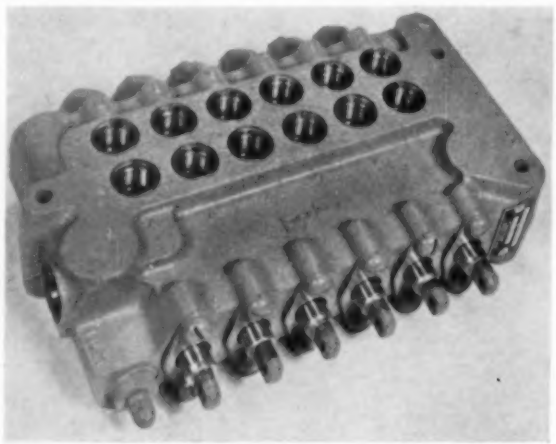
When a series or series/parallel valve is shifted to extend the cylinder which is controls, it shuts off pump flow to all valves downstream. However, fluid from the cylinder rod end (if the cylinder is double-acting) flows through the downstream valves in a series arrangement. This flow is often used to start a second movement before completing the first. If a single-acting valve is used as the first valve in the stack, no fluid will be available for downstream valves while the single-acting cylinder it controls is extending.

The additional position on a 4-position directional control valve is generally a *float* position. When the valve is in *float*, all ports are connected to tank, as in the center position of an open-center valve. The float position is used for applications such as controlling the blade on a dozer or snow plow. With the control valve in *float*, the blade follows the contour of the ground. Its only resistance to movement is fluid friction in the cylinder lines and valve. A detent holds the valve in this position.



Courtesy Racine Hydraulics & Machinery

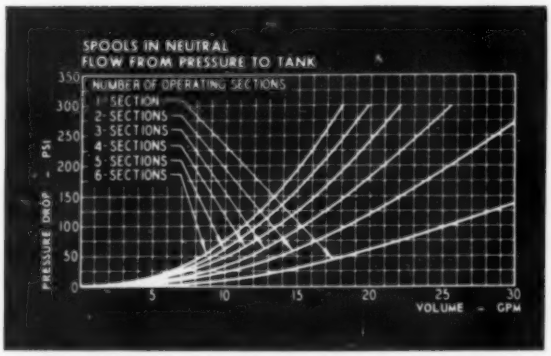
3-VALVE STACK has one solenoid, pilot-operated valve, one lever-operated valve, and one hydraulic, pilot-operated valve.



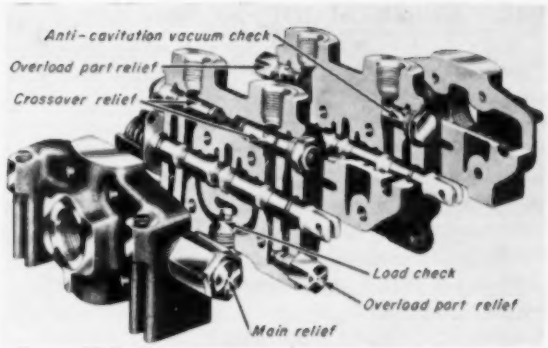
Courtesy Parker-Hannifin Corp.

Courtesy Vickers, Inc.

MULTIPLE VALVE BANKS may be all in one body or made up of separate sections bolted together. The unit body construction (top) has cored fluid passages in the valve body. Ports in the sectional valves (bottom) are sealed with O-rings between sections.

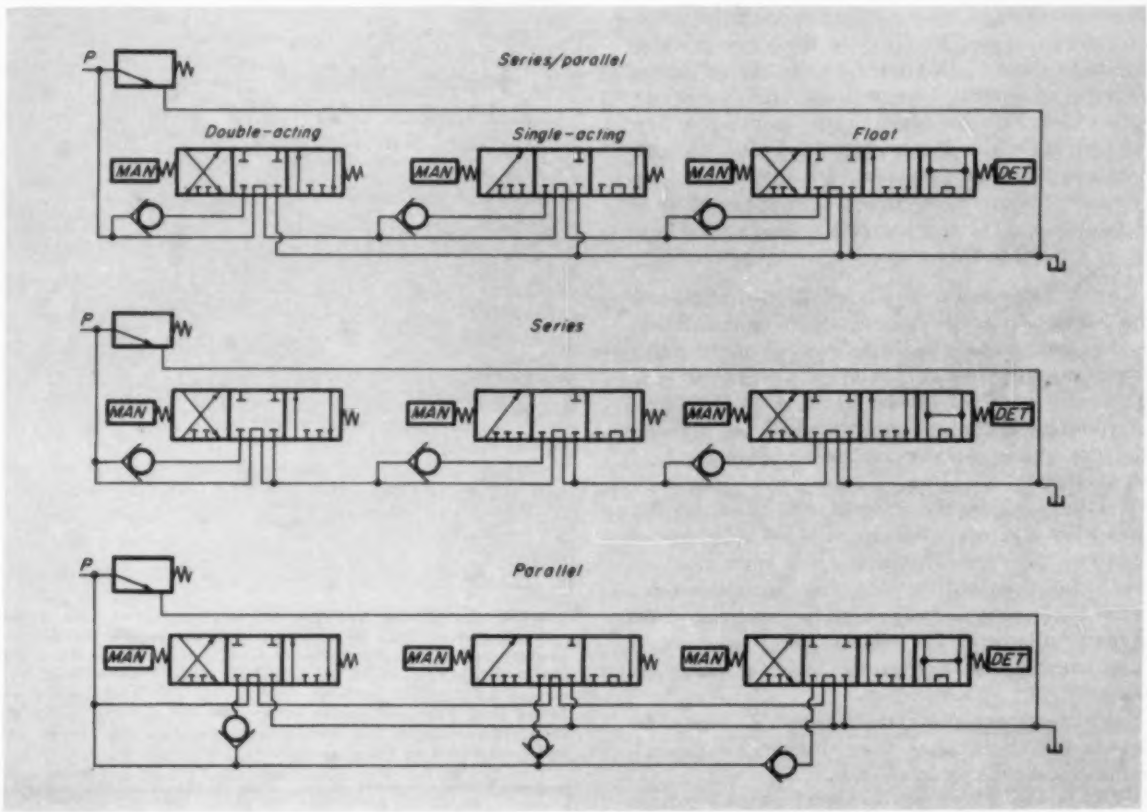


PRESSURE DROP through stack valves increases directly with the number of sections in the stack. Curves show characteristic performance.



Courtesy Commercial Shearing & Stamping Co.

CROSSOVER RELIEF VALVES relieve pressure in either direction from one work port to the other. They protect the cylinder from overpressure and shock.



THREE INTERNAL PORTING ARRANGEMENTS for mobile directional control valves have double-acting, single-acting, and float valves. In their center position, fluid flows from the pressure port through the valves to tank. In the series valve, while extending or retracting a double-acting cylinder, fluid displaced by cylinder movement may be used to start movement of another cylinder downstream. With the series/parallel arrangements, only one cylinder can be moved at a time. In the parallel valves, if two valves are shifted at once, only the one with the least load will extend.

• **Valve Types**—Most mobile equipment directional control valves are either spool or sliding plate type. These designs permit a variety of porting designs. Flow paths through the valves can be altered quickly by changing the spool or slide. Both have some internal leakage for lubrication. Most spool valves are rated at 2500 psi operating pressure and plate valves at 6000 psi. Rotary plate valves with pressure loaded sealing faces are available for pressures to 10,000 psi. However, pressures above 6000 psi are seldom used on mobile equipment.

• **Valve Actuators**—The operator on most mobile equipment must coordinate cylinder motion by observ-

ing position and rate of movement. He is his own servo system and must have full control of the directional valves. For this reason most mobile directional control valves are manually operated.

Valve actuating levers generally attach to a fulcrum mounted at one end of the valve. Movement of the lever moves the spool or slide. These valves are generally spring-centered. If the valve has more than 3 positions, a detent mechanism holds it in its additional positions.

A mechanical linkage is sometimes used to connect the operator's station with the directional control valves. This is done only when it is not convenient to mount the valves within reach of the operator.

Another method of remote control for mobile directional control valves is a hydraulic slave system. This system uses a master cylinder connected to a slave cylinder. The piston rod of the slave cylinder connects to the actuating lever on the control valve. This type of control is sometimes used on utility trucks which have an aerial boom carrying a line repairman aloft. The master control is in the cab with the lineman, and the slave control is mounted on the directional control valve. This system not only gives accurate control but also prevents grounding the lineman as a metal linkage would do.

• **Check Valves**—Practically all directional control valve banks have at least one check valve built in. It prevents load drop from back flow when the valve shifts. Many valve blanks have integral check valves in the pressure line to each valve in the stack. They prevent interflow within the valve caused by pressure difference of one cylinder supporting a heavier load than another.

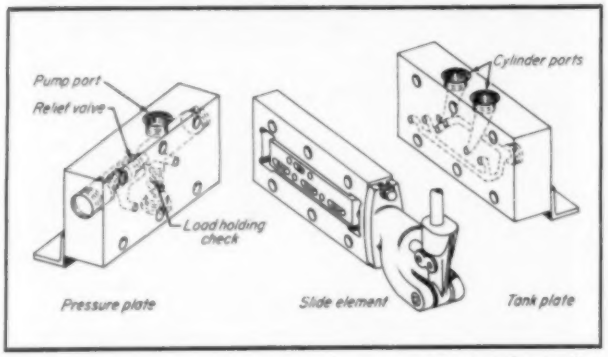
A check valve is also used in directional control valves when a regenerative circuit is set up in one of the valve's positions. This position is often used on dozer valves to extend the blade fast. The check valve lets fluid flow from the rod end to the head end of the cylinder. An integral, low pressure relief valve breaks the differential circuit when the cylinder meets resistance.

When an accumulator system is used, a check valve prevents the accumulator from discharging through the pump while the pump unloads.

Pilot-operated check valves are often used to support heavy cylinder loads which would otherwise drift due to leakage through the directional control valve. They are installed in the line from the directional control valve to the cylinder. Fluid flows through the pilot check valve to the cylinder. Return flow is blocked until the directional control valve shifts and applies pilot pressure to the pilot check valve.

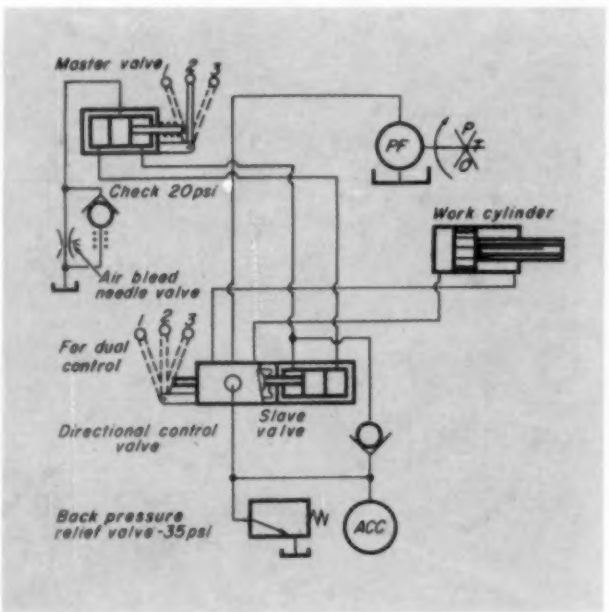
Most integral check valves are ball type because they require less space and fewer machining operations than poppet check valves.

• **Relief Valves**—To get maximum efficiency from a mobile hydraulic system, the operating pressure is held as close to the design maximum pressure as possi-



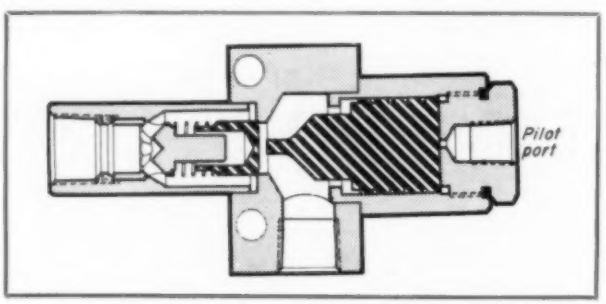
Courtesy Dynex, Inc.

SLIDING PLATE VALVE may be assembled as a single valve, or up to six sections can be bolted together to form a stack. It has a drilled slide enclosed between a pressure plate and a tank plate.



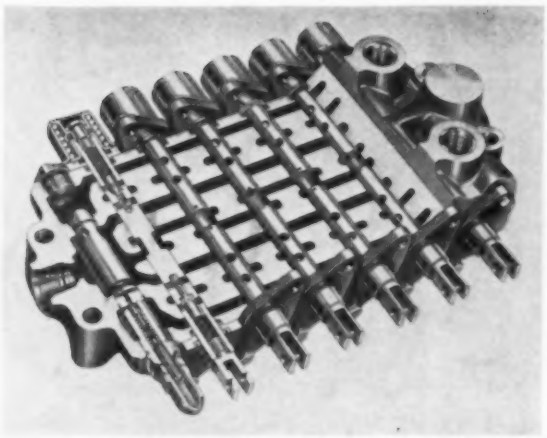
Courtesy Dynex, Inc.

REMOTE CONTROL SYSTEM for valve actuation uses a closed hydraulic system. Fluid from the pump flows through the directional control valve and backpressure relief valve to tank. The accumulator, charged with fluid at 35 psi, keeps the system full of fluid by replacing oil returned to tank through the air bleed needle valve. Excess fluid from the master valve flows through the 20-psi check valve. Movement of the master valve displaces fluid which causes equal movement of the slave valve.



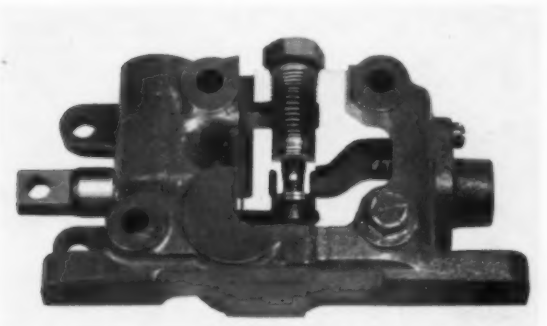
Courtesy Fluid Controls, Inc.

PILOT CHECK VALVE prevents cylinder creep caused by directional control valve leakage. Pressure applied to the pilot port opens the valve for free reverse flow.



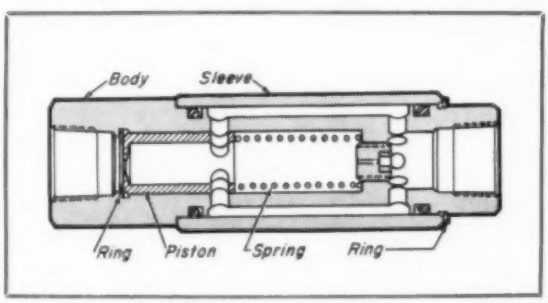
Courtesy Hydreco Div. New York Air Brake Co.

DRILLED SPOOLS hold check valves to prevent back flow through the valve while shifting. Pilot-operated relief valve prevents overpressure at pressure port.



Courtesy Vickers, Inc.

PILOT-OPERATED RELIEF VALVE in inlet section allows minimum pressure override and high system efficiency.



Courtesy Waterman Hydraulics, Inc.

FLOW CONTROL VALVE is pressure compensated to pass constant flow regardless of pressure. One use for this type of valve is to assure a constant lowering speed of the lift cylinder on fork lift trucks regardless of the weight of the load.

FLOW REGULATOR delivers a fixed flow to one circuit and bypasses the remaining pump output to another circuit. One use for this valve is to deliver a small portion of pump output to power steering and the remainder to the load manipulating circuit.

ble. The relief valve is generally set a little above operating pressure to prevent overloading.

A small differential between cracking pressure and full open pressure is important for effective system operation. If, for example, the relief valve on a lift truck is set to crack at maximum operating pressure, this pressure will be exceeded with greater flow through the relief valve. However, if the relief valve is set to limit maximum pressure at full flow, the capacity of the truck will be reduced at lower flows.

Pilot-operated relief valves maintain maximum system pressure through a greater range than direct-acting relief valves. These valves have a small pilot relief valve that controls the main relief valve when the pressure setting is reached. This permits operating the system at its maximum rated pressure through almost the entire pump range. Because of the small passages or orifices in the pilot section, systems using pilot-operated relief valves must be well filtered.

Direct-acting relief valves are sometimes used where failure to close would be hazardous to personnel or equipment. They also respond to shock pressure more quickly than pitot-operated valves.

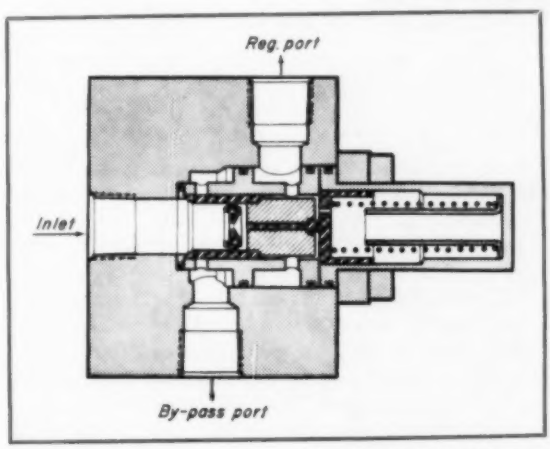
Most directional control valve banks have a built-in relief valve to prevent overpressure at the pump port. Some have a relief valve in each individual valve section to permit setting a different maximum pressure for each cylinder.

• **Flow Control Valves**—Closely controlled cylinder speeds are usually not required on mobile equipment. However in applications such as lowering the load on a lift truck, speed must be controlled for safety. Most lift trucks have a pressure-compensated flow control valve connected to the lift cylinder's outlet port. This assures constant lowering speed regardless of the load. At least one manufacturer supplies a pressure-modulated valve for lift trucks. This valve lowers a light load more rapidly than a heavy load.

Adjustable flow control valves also regulate fluid motor speed on mobile augers and mining equipment.

One type of flow control valve that delivers a fixed portion of pump output to one circuit and bypasses the remaining output to another circuit is some-

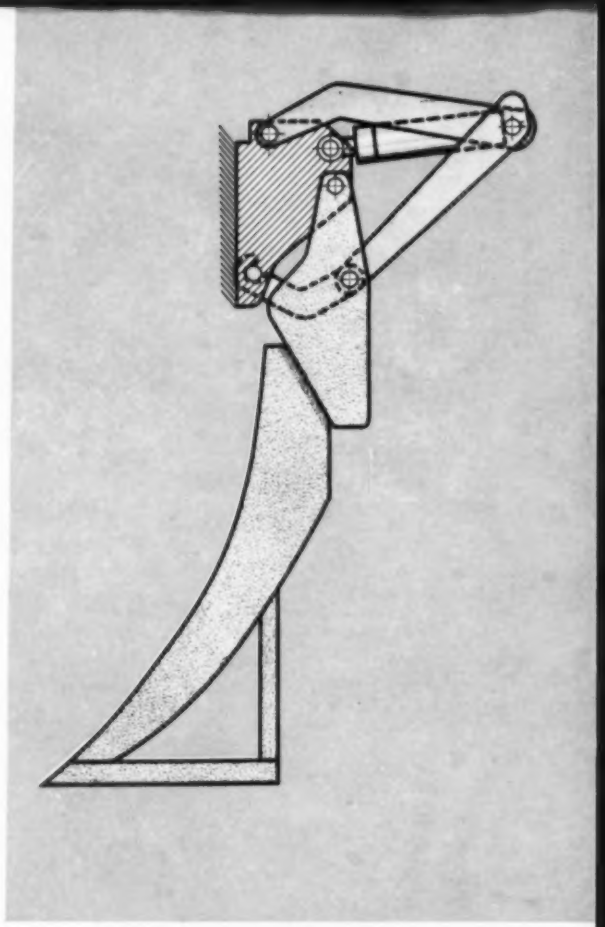
Continued on page 98

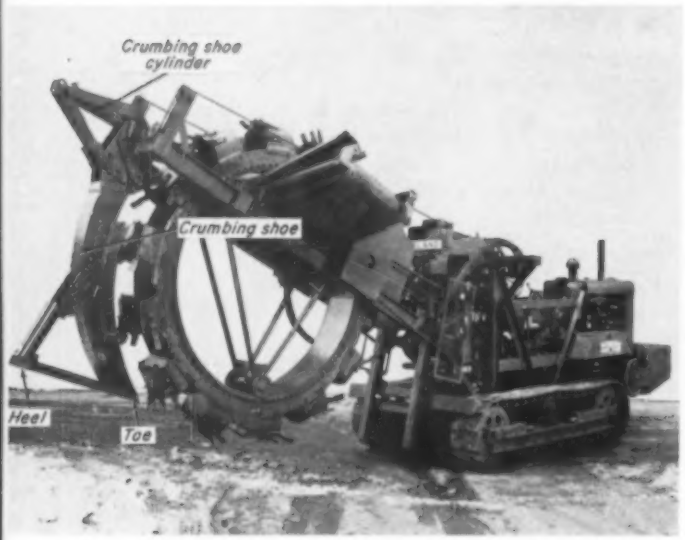


Courtesy Fluid Controls, Inc.

Four bar hydraulic linkage controls trencher's crumbing shoe

• *By* **HENRY L. MEYER** *and* **FRED R. WILHELM**, *Project Engineers, Cleveland Trencher Co., Cleveland, Ohio*





HYDRAULIC CYLINDER in crumbing shoe 4-bar linkage positions shoe and locks it.

THE HYDRAULIC crumbing shoe at the rear of this trenching machine serves four purposes:

- Shifts machine's center of gravity forward to give it better traction
- With the weight of the rear wheel supported by the shoe, depth control is adjusted only at front end of the wheel. This provides accurate grade control
- Scrapes up lose dirt in the trench
- Smoothes the trench bed ready for tile or pipe

When the shoe is in normal operating position, the desired digging depth can not be reached quickly. For a quick start, the shoe is swung vertically out of the way. When desired digging depth is reached, the shoe is swung into the trench. The shoe is also raised when starting a trench near obstructions such as buildings or fences.

• **Constant Cylinder Speed Design**—A variable displacement, 5 to 17-gpm pump supplies the linkage circuit. System relief is set at 2000 psi, and it requires 1100 psi to raise the crumbing shoe. The shoe used to go down too fast, so it was slowed down by adding a flow control valve to the circuit. Later we found we could do without the valve if we restricted flow by undersizing the cylinder hose.

At first a ¼-in.-ID hose was selected. The Reynolds Number for a minimum pump flow of 5 gpm was calculated.

$$R = \frac{\rho v d}{\mu}$$

where ρ is the density in slugs/ft³
μ is absolute viscosity in lb sec/ft²
v is velocity in ft/sec
d is the hose ID in ft

$\mu = 29$ centipoise

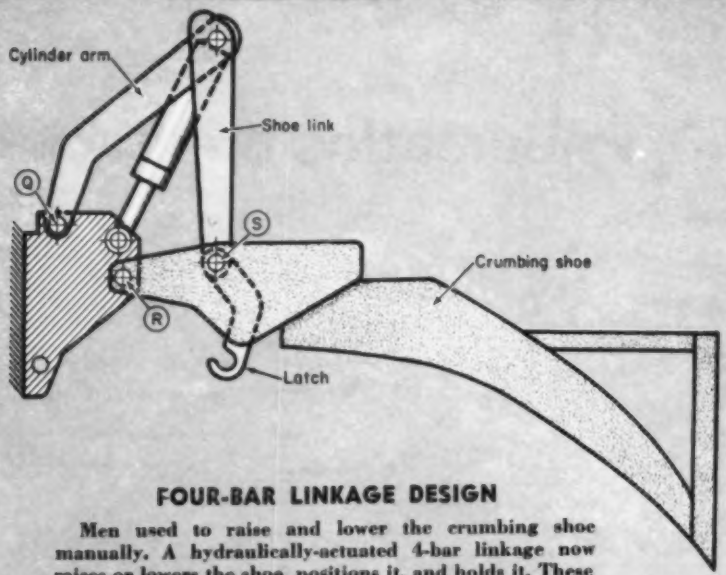
$$= \frac{29}{47{,}880} = 0.00061 \text{ lb sec/ft}^2$$

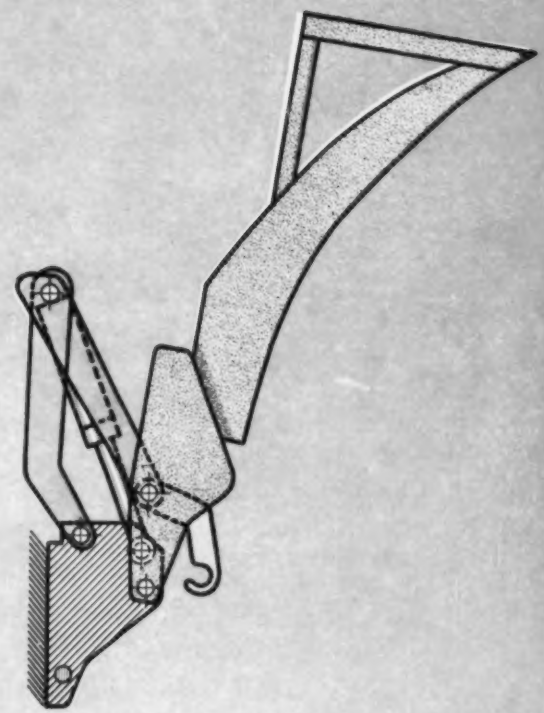
$$\rho = \frac{54 \text{ lb/ft}^3}{32.2} = 1.68 \text{ slugs/ft}^3$$

$$v = \frac{5 \times 231 \times 4}{12 \times \pi \times 60 \times (.25)^2} = 32.8 \text{ ft/sec}$$

$$R = \frac{1.68 \times 32.2 \times 0.021}{0.00061} = 1930$$

A Reynolds Number of 1930 indicates laminar flow.





FOUR-BAR LINKAGE DESIGN

Men used to raise and lower the crumbing shoe manually. A hydraulically-actuated 4-bar linkage now raises or lowers the shoe, positions it, and holds it. These bars make up the linkage:

- ***Cylinder Arm*—When the cylinder extends, the cylinder arm pivots about point *Q* and lifts the shoe link.**
- ***Shoe Link*—As the cylinder continues to extend, the shoe link lifts the shoe out of the trench.**
- ***Shoe Body*—The crumbing shoe swings out of the ground pivoting about point *R*, on the boom frame.**
- ***Latch*—This link is free to rotate about pivot S. The first half inch of cylinder stroke unhooks the latch. The remainder of the stroke raises the shoe.**

We estimated the circuit would need the equivalent of 71.5 ft of hose, and would have a fixed pressure drop of 157 psi through the check valves, control valve and filter. Since 1100 psi were required to maneuver the shoe, and there would be a 157 psi pressure drop in the component parts, a 743-psi pressure drop restriction had to be incorporated into the hose.

$$\Delta P \text{ per 100 feet} = 0.0273 \frac{\mu Q}{d^4}$$

$$743 = \frac{71.5}{100} \times \frac{.0273 \times 29 \times 5}{d^4}$$

$$d = .248 \text{ in.}$$

This diameter shows that ¼-in.-ID hose is suitable.

• **Positive Shoe Positioning**—The shoe must be held positively in all selected positions. In the raised position, it must be held to protect the workmen near the machine. In the lowered position, it must be locked to resist digging forces. A shear pin protects the shoe against overloads.

Due to the inherent leakage in spool type directional control valves, a double pilot-operated check valve was installed in the circuit to hold the shoe in the desired position. Pilot-operated check valves require that cylinder ports be open to the low pressure side of the circuit when the control valve is in neutral. Any impulses in the series circuit, would, however, unseat a check valve, and let the cylinder move. Because the slightest cylinder movement would unlatch the shoe from its normal operating position we stopped surges in the circuit from unseating a check valve by moving the shoe control valve section to last place in the series valve bank. This nullified the effects of surges in the low pressure side of the system.

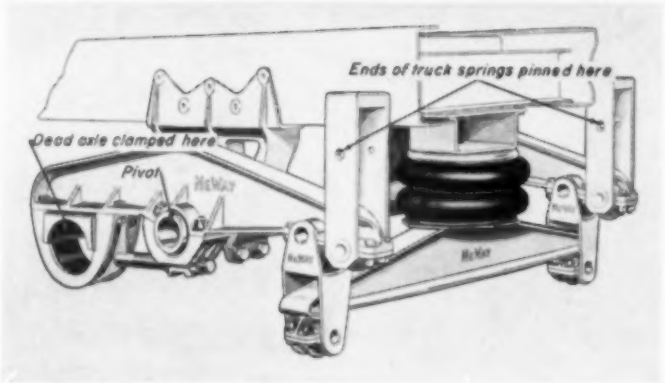
• **Positive Linkage Latching**—The hydraulic cylinder performs a double duty in this linkage: it actuates the shoe and locks it. At the end of the lowering cycle the final half inch of cylinder stroke (in combination with the action of the latch) locks the shoe in working position. When locked, the cylinder needs only to hold the latch because the latch itself absorbs all the digging forces exerted on the shoe. A relief valve is connected to the cylinder rod-end to protect the system should the shoe accidently become unlatched.

It was necessary to find a way that would give us sufficient leverage to lift the shoe during the first few inches of cylinder stroke. In the geometry of this linkage, when the cylinder extends, leverage first increases, then decreases as the cylinder approaches its fully extended position and nears the over-center position. When folding linkages go over center they lock and must be freed before the machine can operate again.

When the crumbing shoe is in its raised position, the hydraulic cylinder rod-end is pressurized to start the shoe on its way down. After a few inches of stroke, the weight of the shoe actually pulls it down and the cylinder hose controls the down speed. ▼▼▼

Pneumatics on mobile

The number of air systems on mobile equipment is continually increasing. Compressors, used in the past only for air brakes, are getting larger to handle such systems as tire inflation, transmission shifting, leveling, engine starting, and main propulsion In some equipment, air is used instead of hydraulics because it operates in an area where hydraulic fluid would create a fire hazard. In equipment which has air available, additional systems can be added for less cost than installing a hydraulic system. Here are some examples of work being done by pneumatic systems on mobile equipment

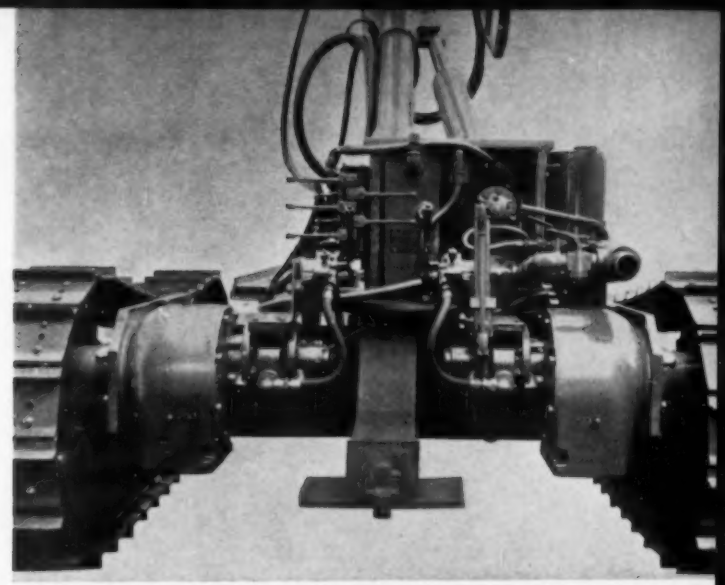


AIR SPRING shifts load from dead axle to driving axle. This attachment made by Neway Equipment Co. allows truckers to carry increased loads by converting from single to tandem axle operation. The shackles slip over the ends of the original springs of the truck. This distributes the load equally between the two axles. For additional traction, the driver actuates an air valve in the cab and increased the air pressure in the double-convolution air spring. This pivots the beam removing up to 4000 lbs from the dead axle and applying it to the drive axle.

Courtesy Greer Hydraulics, Inc.

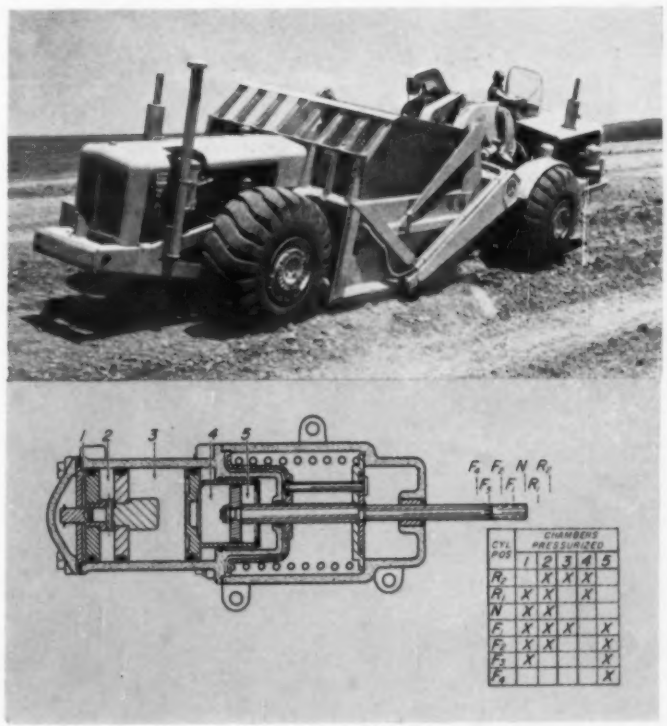
HYDRO-PNEUMATIC ACCUMULATORS serve two purposes on these lift trucks. The piston type accumulator behind the mast in the photo at right connects to the lift circuit. It serves as a shock-absorber for the load while traveling over uneven floors or rough ground. The bladder type accumulator mounted next to the driver in the photo above is in the clamp circuit. It maintains pressure to the clamp cylinder by replacing fluid lost through internal leakage in the clamp directional control valve.

equipment



8-HP AIR MOTORS drive the track on this crawler drill. Another air motor drives a hydraulic pump supplying fluid for the mast positioning cylinders. The drive motors develop enough torque to permit the crawler to pull its portable compressor. *Information courtesy Worthington Corp.*

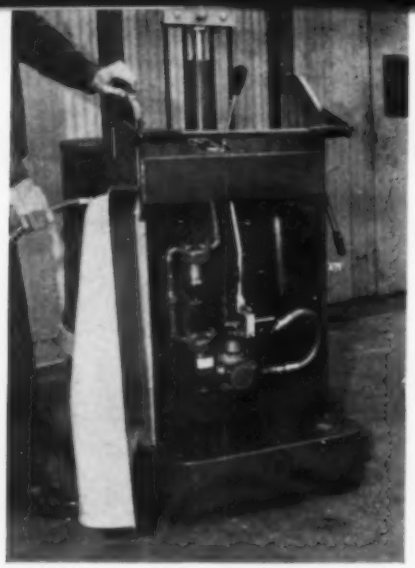
AIR MOTOR turns an eccentric weight in this heavy duty car shaker. Vibrator delivers an impact of 6600 pounds at 3000 cycles per second. The shaker designed by Martin Engineering Co. is used for unloading railroad cars filled with flowable solids.



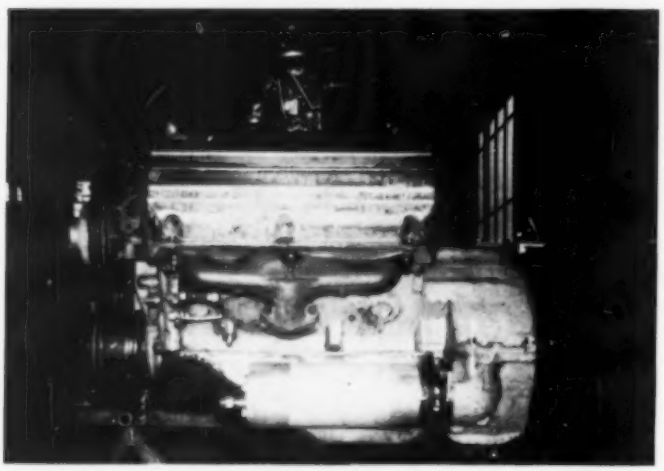
7-POSITION AIR CYLINDER shifts the transmissions on this large twin scraper built by Euclid Div., General Motors Corp. The front and rear transmission control cylinders (drawing) are connected in parallel. The scraper has four speeds forward, two reverse, and one neutral position. The table shows which chambers are pressurized for the various positions. The spring shifts the transmission to neutral if air pressure is lost. An electrical switch at the control valve closes the starting circuit only when the transmission is in neutral.

Courtesy Parker-Hannifin Corp.

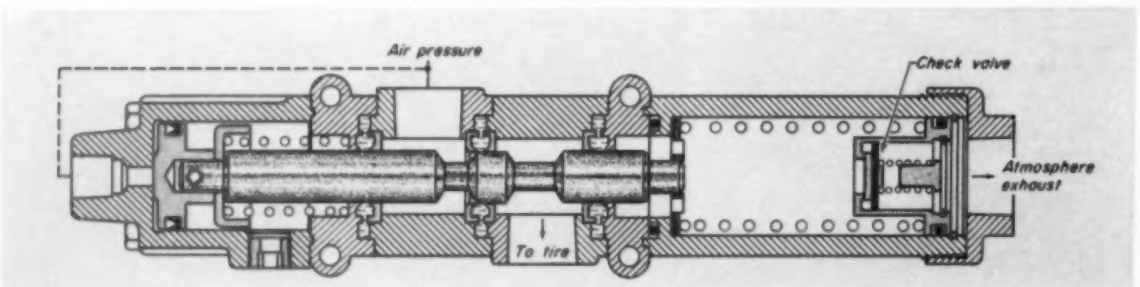
PNEUMATIC GUN blasts concrete for pool lining, tunnels, reservoirs, etc. A rotary 4-way valve controls the machine's slide valve which is actuated by an air cylinder. An air motor drives an agitator to keep cement flowing into the discharge line. *Information courtesy Barksdale Valves.*



AIR-OPERATED LIFT TRUCK with 2000-lb load capacity has a hydraulic pump driven by a 3-hp air motor. The truck which is made by The American Pulley Co., is used in hazardous locations where an electric spark could cause an explosion. A quick-connect coupling on the truck allows it to be connected to any shop air hose. Air to the motor flows through a filter and lubricator. A pressure regulator maintains a constant, 60-psi air supply to the truck.



RECIPROCATING PISTON AIR MOTOR has starting torque of 14 ft-lb. Used for diesel engine starting, the motor develops 3 hp at 2000 rpm. It is used on trucks and buses which have air available for braking. Cold weather does not reduce starting torque as it often does with an electrical starting system. *Information courtesy Humphrey Products Division, General Gas Light Co.*



TIRE INFLATION VALVE is part of a pneumatic system that lets the driver inflate and deflate the vehicle's tires while it is moving. Air for the system is supplied by two belt-driven compressors. After flowing through the pressure controls in the cab, the air is piped to a pressurized bell housing on the inside of each wheel. Sealed ports through the axles carry the air to the outside of the wheels and through airlines to the inflation valves at the tires.

When air pressure is applied to the inflation valve, the spool shifts to its open position. The spool movement is caused by air pressure at the pilot port. Air then flows into the tire. At 85 psi the spool travels far enough to block air into the valve. If pressure increases above 85 psi the spool moves farther, opening the circuit to atmosphere and deflating the tire. A spring-loaded check valve in the exhaust prevents the tires from being deflated below 10 psi. *Courtesy Westinghouse Air Brake Co.*

REDESIGNED GRADALL has one engine to power its hydraulic drive and hydraulic boom.

Hydrostatic drive replaces engine

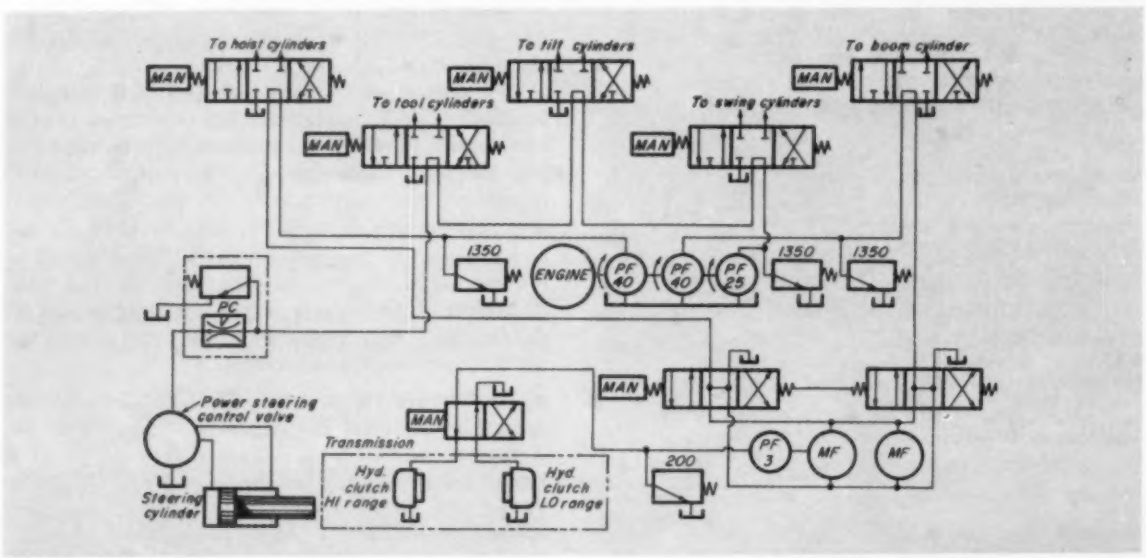
• By **KEITH BROWNFIELD**, *Supervisor, Production Engineering, The Warner & Swasey Co., New Philadelphia, Ohio*

This earthmover had two engines before its conversion to a hydraulic drive. One propelled it, the other powered the hydraulics. The conversion eliminated one engine. One engine now supplies all the power the machine needs.

TWO MAIN sections make up a standard Gradall earthmover: the upper works and the undercarriage. The machine used to have one engine on the upper works to power the hydraulic boom, and another engine on the undercarriage to propel the machine. This design had these disadvantages :

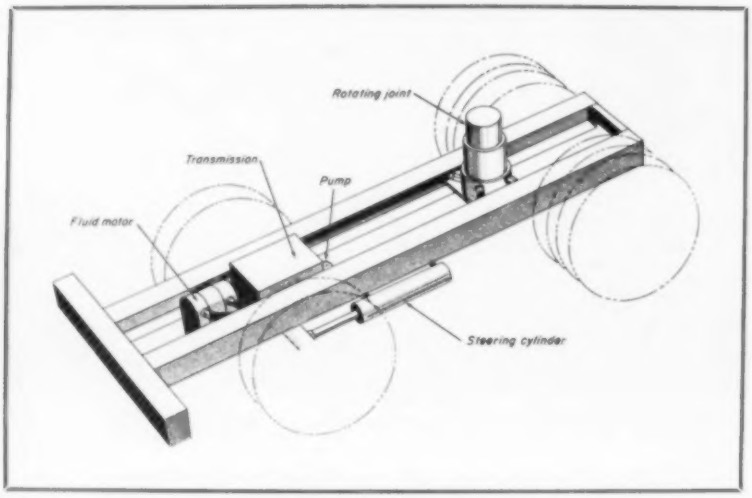
- Two engines were needed.
- The undercarriage engine had to run continually to drive the air compressor for the brakes.

Continued on next page



THREE-SECTION PUMP supplies the power to propel the Gradall and actuate its boom. To move the machine, oil from the two 40-gpm sections is diverted from the boom to the transmission. Fluid for the power steering circuit is drawn off the 25-gpm section of the pump.

ROTARY JOINT has eleven passages to transfer oil and air from the upper works to the undercarriage.



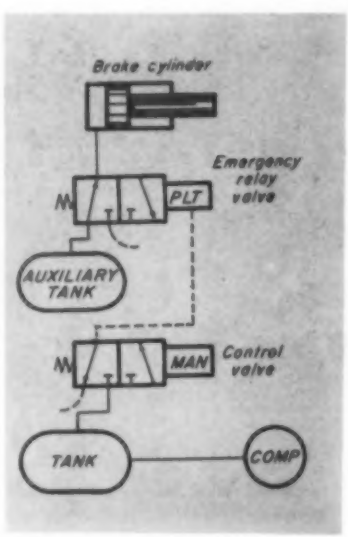
UNDERCARRIAGE SUPPORTS hydraulic transmission and motors, control valve pump, power steering cylinder, and rotary joint.

- Remote controls from the upper works to the undercarriage were expensive.

We modified the undercarriage of a standard Gradall from a conventional torque converter drive to a hydrostatic drive. We eliminated the undercarriage engine, diverted oil from the upper works to the undercarriage through a rotary joint, and used this oil to drive the machine's transmission. One engine now supplies power to propel the machine, and actuate its hydraulic system.

An 80-hp engine drives a 3-section pump which delivers 40, 40, and 25 gpm at 1350 psi to the hydraulic system. The pump feeds the oil to a valve manifold which distributes it to the boom's five control valves on the upper works. The pump's two 40-gpm sections normally supply the boom in-out and up-down operations. When the earthmover travels, however, the boom is idle. Fluid from these sections of the pump is diverted to a 2-section hydraulic motor which drives the machine through a gear transmission.

A small transmission-driven pump delivers oil from the transmission housing, through a rotary joint, to a control valve in the cab. The transmission housing acts as a reservoir. The rotary joint connects oil and air lines from the upper works to the undercarriage. The control valve actuates the high and low range clutches. The transmission has a high speed of 10 mph. A 5:1 reduction also gives it a low speed of 2 mph with high torque.



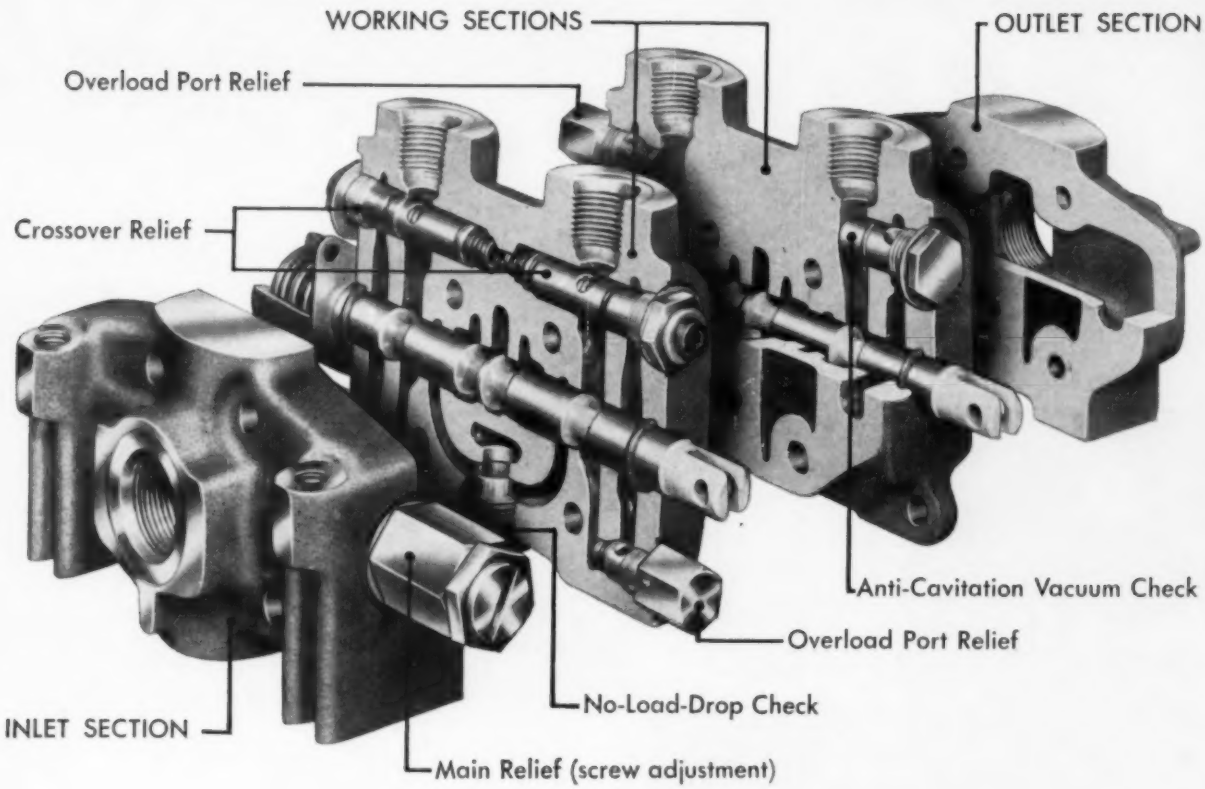
CIRCUIT DIAGRAM of brake pneumatic system. Two air tanks are used to set and release brakes.

• **Power Steering Circuit**—The power steering circuit has a remote, rotary servocontrol unit in the cab. Fluid for the steering circuit is diverted from the 25-gpm pump section through a flow divider (pressure-compensated, flow control valve). This valve draws off about 6 gpm to actuate the hydraulic cylinder connected in the steering linkage circuit. Excess oil returns to tank.

The remote steering control unit performs two functions. Under normal steering conditions, it acts as a control valve. Should pressure fail, the valve becomes a pump, and supplies fluid to steer the machine manually.

• **Rotary Joint Design**—To transfer oil from the upper works to the undercarriage, we designed a rotating joint. Ten oil lines and one air line pass through it to the undercarriage. The inner section of the rotating joint is connected to the upper works, the outer section to the undercarriage.

• **Brakes are Pneumatic**—The Gradall has standard brake cylinders. The engine is fitted with an air compressor and air tank. A manual valve controls the brakes from the cab. When the valve is off, the brakes are set with air from a small auxiliary tank mounted on the undercarriage. When the control valve is on, air from the upper works tank actuates an emergency relay valve which shuts off the auxiliary tank, and lets the brake cylinder bleed. ▼▼▼



Only 12 psi drop in new 2000 psi valve

For earth moving, mining, materials handling, agriculture and ground support equipment

COMMERCIAL Model A, series 20 and 35 manually operated parallel circuit valves directionally control fluid power up to 2000 psi. Internal pressure drop has been reduced at least 50% compared to earlier models. Back pressure in the exploded A20 valve, illustrated, having two working sections, is only 12 psi at 20 gpm through flow–all spools neutral. Under same conditions, valve having six working sections records back pressure of only 33 psi. Performance of the A35 valve is equally outstanding. Complete, all-condition performance ratings are available–proving quite revealing.

Exclusive Easy Access Features

- MAIN RELIEF VALVE controls system relief pressure–circuit loaded
- NO-LOAD-DROP CHECK blocks pressurized return flow
- FLOW RESISTOR CHECK controls rate of cylinder movement
- OVERLOAD PORT RELIEF prevents pressure build-up beyond port–spool neutral
- ANTI-CAVITATION VACUUM CHECK releases vacuum build-up in cylinder
- CROSSOVER RELIEF protects against shock load–spool neutral

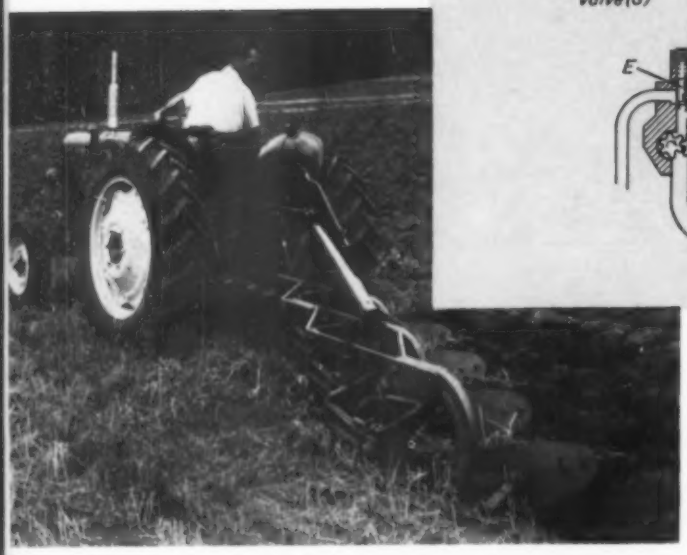
Smooth, Precise Operation–COMMERCIAL's new, rugged, heavy-duty valves eliminate jerky, erratic movements of equipment common to ordinary valving. Highly sensitive and positive is their action. Just "velvet touch", finger tip, spool operation meters the most precise and delicate flow. Feel of equipment motion actually "plays back" through the spool handle.

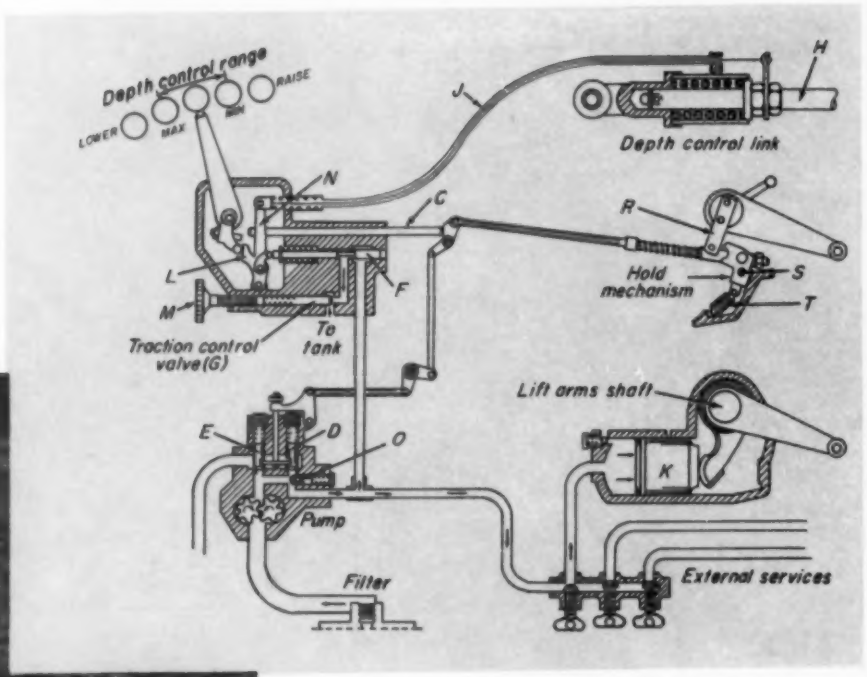
Control Functions for All Needs–Working sections can be assembled in tandem, in any sequence. Sections with 3 or 4 spool positions are available with spring return or detented spool actions. Single acting, double acting, hold or float actions are all available. Complete hydraulic system and equipment protection can be yours–built right into Model A valves–without external piping.

Technical Service and Literature–Experienced technical service and assistance is available from our factory-based personnel. Bulletin 100-P16 gives full data on the new Model A valves. Address: Commercial Shearing & Stamping Company, Dept. A-36, Youngstown 1, Ohio.

pumps, valves, cylinders, motors

COMMERCIAL *shearing & stamping*





Hydraulic servo system regulates implement depth

This tractor hydraulic system regulates implement depth when towing implements without depth wheels, and controls the tractor's rear wheel traction when hauling implements with depth wheels. Both of these functions are regulated by a single control lever.

SOME farm implements have depth wheels to regulate cutter depth. These wheels attach to the implement's chassis and the cutters adjust to a set depth below them. The hydraulic system on this tractor made by The David Brown Corp. Ltd., Huddersfield, England, increases traction on the tractor's rear wheels when implement drag increases enough to cause wheelspin.

The tractor also hauls implements without depth wheels. With these implements, the hydraulic system regulates the depth which the implements dig into the ground.

Continued on page 96

Circle 9 ➔

BASIC for Process Control

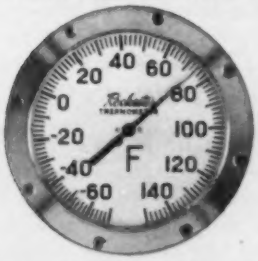
Process engineers searching for a single source for a wide variety of products are sure to find the value of these American-Standard Controls Division products. This is true of anyone who must control or indicate the pressure or temperature of gases and fluids or electrical energy.

High Pressure Gauges

Accuracy plus elimination of recalibration are built-in features of the Rochester line of high pressure gauges manufactured by American-Standard Controls Division. No moving parts—no friction—makes it virtually impossible to wear out this gauge. Life expectancy is more than 250,000 cycles based on use from 0-50% of scale range. Available with adjustable mounting ring for flush or panel mounting. Dial size 4½" or 6". For pressure applications up to 10,000 psi.

AMERICAN-Standard
CONTROLS DIVISION

Industrial Thermometers



Rochester bimetal industrial dial thermometers provide extreme accuracy, are hermetically sealed and can be externally calibrated. Available in standard dial sizes from 1" to 5", and with scale ranges from minus 150°F to 1000°F.

AMERICAN-Standard
CONTROLS DIVISION

You can get detailed information on any of these products by writing American-Standard Controls Division, 5900 Trumbull, Detroit 8, Michigan.

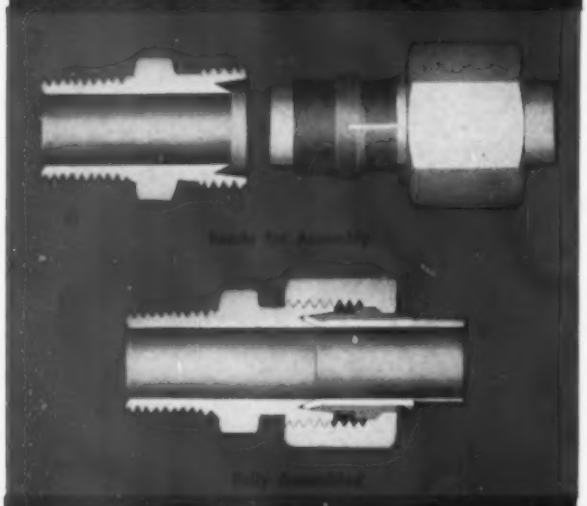
Pressure, Temperature Controls

ASCD makes a wide variety of heavy duty controls for either pressure or temperature applications. They are extraordinarily rugged, can be designed to meet almost any condition.

AMERICAN-Standard
CONTROLS DIVISION

AMERICAN-Standard
CONTROLS DIVISION

Reduce Installation and Replacement Costs .. Prevent Leakage with



FLODAR
Self-Flare Tube Fittings

The Efficiency Of A Flare Fitting — Can be used on thin wall tubing — provides a seal on the ID of the tube.

The Easy Installation Of A No-Flare Fitting — no time consuming flaring operation — no flaring tools required. Can be used with heavy-wall tubing and, provides a seal on the OD of the tube.

- Easy Assembly — Simply insert tube into fitting and tighten nut. "Rock Bottom" stop and signals that joint is sealed.
- Double Seal — seals on both outside and inside of the tube.
- Lower Cost — FLODAR'S Self-Flare fittings cost less to buy and install.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

Priced competitively, this fitting is available in tube sizes from ⅛" to 2" and in steel, stainless, brass and aluminum.

The Complete Line of FLODAR Products

- Flare & No-Flare-Type Fittings
- High Pressure Pipe Fittings
- Straight Thread Tube Fittings
- Metal-to-Metal Porthole Fittings
- "O"-ring Type Porthole Fittings

Send for a copy of FLODAR'S tube and pipe fitting catalog.

STOCKS IN ALL PRINCIPAL CITIES

FLODAR Corp.
16911 ST. CLAIR AVENUE • CLEVELAND 10, OHIO

Circle **55** on Reader Service Card

HYDRAULIC SERVO SYSTEM

• **Depth Control**—The depth control link shown in the drawing is spring-loaded. Rod *H* connects to the top of the implement and compresses the spring when the implement digs into the ground. The implement's depth is transmitted to the control valve through the flexible cable *J*.

With the lever in *LOWER*, the abutment screw pushes rod *C* to open valves *D* and *E*. Pump output flows to tank and the implement sinks into the ground.

The lever is then placed in *DEPTH CONTROL*. Valves *D* and *E* close and valve *F* opens. Pump fluid then flows to tank through valve *F*, opening traction control valve *G*. The implement lowers until rod *H* compresses the spring in the depth control link. This movement is transmitted to the control valve *F* through flexible cable *J* and lever *N*. As implement depth increases and decreases, valve *F* opens and closes varying the pressure on piston *K* and maintaining the implement at its set depth.

In the *RAISE* position, valve *F* is held closed and full pump pressure applied to piston *K* lifts the implement.

•**Traction Control**—When towing implements with depth wheels the lever is moved so that pivot *L* holds valve *F* open. Pump valves *D* and *E* are closed. Pump delivery flows through the traction control valve to tank. Pressure acting on piston *K* is regulated by setting the handwheel *M*. Tightening down handwheel *M* increases pressure on piston *K* tending to lift the implement. This transfers some of the implement's weight onto the rear wheels of the tractor and prevents wheelspin.

When the valve lever is moved to *RAISE*, lever *N* moves clear of valve *F*. The valve is then closed by its spring, and the implement lifts.

As the implement reaches its raised position, lever *R* contacts trip lever *S* on the hold mechanism. Lever *S* rotates until the spring-loaded toggle *T* snaps the mechanism over and opens pump valve *D*. This unloads the pump to tank. Valve *E* and check valve *O* trap fluid in the line to cylinder *K*, holding the implement up.

The system also supplies pressure fluid for external hydraulic functions. Cable *J* is disconnected from depth control link *H*. The hand lever then actuates valve *F* which controls flow to external services by varying the pump flow returned to tank. ▼▼▼

PLAN TO ATTEND

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS
Chicago October 19, 20

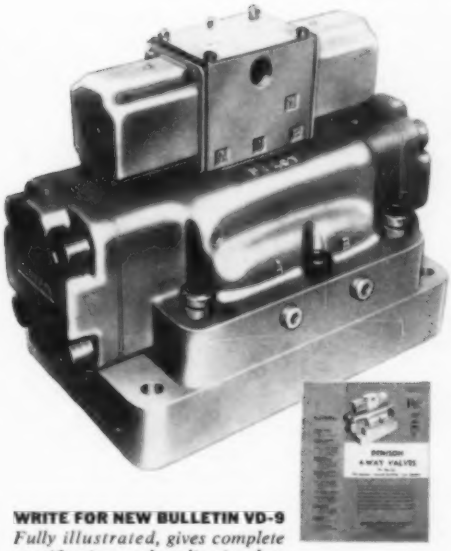
Program and abstracts of the papers will be presented next month in HYDRAULICS & PNEUMATICS.

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

Get 7 important advantages for smooth directional control with these **NEW** 1½" 5000 psi hydraulic...

4-WAY VALVES



WRITE FOR NEW BULLETIN VD-9
Fully illustrated, gives complete specifications and application data for Denison's new 1½-inch 4-way hydraulic valves.

Save space, time and cost on exacting directional hydraulic applications. You can apply shockless, positive directional control to any hydraulic circuit—*by specifying Denison 4-Way Valves.* Stem-operated, pilot-operated, and solenoid-controlled for systems up to 5000 psi, these service-proved valves offer these important features for reliability and design versatility—

Shorter solenoid power stroke permits shorter over-all valve length to speed response. Denison valves deliver fast, rapid-cycle control of flows of 120 gpm.

Drawn steel solenoid covers are secured to body with internal retaining cords. No bulky chains.

Built-in check valve provides pilot pressure without addition of another valve to the system.

Adjustable pilot chokes assure smooth valving action.

Subplate, flange or threaded bodies to suit any type of installation.

Optional lever assembly converts stem-operated valves to manual operation.

Wide choice of spool types and positioning allows handling an unlimited range of applications.

Denison 4-Way Valves also feature large 1½" capacity porting • ample wiring space • interchangeable parts • built to JIC standards.

Contact your nearby Denison hydraulic field specialist for details, or write direct to—

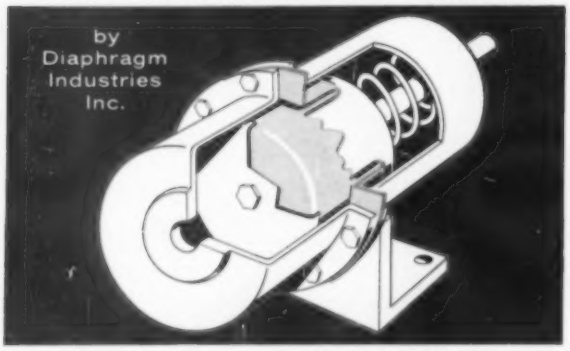
DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC POWER

Circle **45** on Reader Service Card

DIAPHRAGMS AND DIAPHRAGM DEVICES



Rolling, long-stroke, dished, flat, and convoluted diaphragms to meet your specific environmental and operating conditions are offered in a wide variety of elastomer and fabric combinations.

Complete diaphragm assemblies such as actuators, positioners, accumulators and other diaphragm-operated devices are available now in prototype or production quantities.

The rolling diaphragm actuator shown above features:
FRICTION-LESS ACTION • ELIMINATION OF BREAKOUT FRICTION EFFECTS
CONSTANT EFFECTIVE PRESSURE AREA • A LEAKPROOF MECHANISM
EXTREME SENSITIVITY TO PRESSURE DIFFERENTIALS

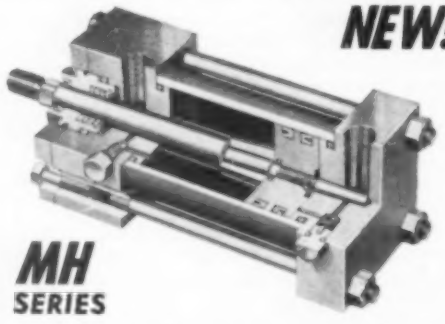
Each elastomer-fabric diaphragm is engineered to fulfill your most stringent specifications: temperatures from −65°F to +550°F; pressures from 1" H_2O to over 500 psi; and compatibility with most gases and fluids.

We welcome the opportunity to quote. Forward complete specifications and details of your requirements for either diaphragms or complete diaphragm assemblies.

Send for free new diaphragm engineering brochure.

DIAPHRAGM INDUSTRIES, INC.

102 RANTOUL STREET, BEVERLY, MASSACHUSETTS • TEL. WALKER 2-1661



NEW!

MH SERIES

COMPACT, MEDIUM PRESSURE, ECONOMY-PRICED HYDRAULIC CYLINDERS!

● Ideal for special or machine tool applications ● Ten bore sizes, 1-½" thru 8" ● Dimensionally interchangeable ● Pressures up to 2000 psi. ● 20 standard mountings ● Straight thread ports at no extra charge ● Tapered cushions ● Multi-lip rod seals, replaceable without disassembly of cylinder ● Meets J.I.C. standards.

Write, NOW, for NEW 20-page full color Bulletin No. 361

Other standard catalogued series cylinders up to 5000 psi in bore sizes 1-½" thru 14". Larger bores on application.

THE SHEFFER® CORPORATION
CINCINNATI 15, OHIO
Phone: POplar 1-8227 • TWX: CI 683
Sold by Leading Distributors Internationally
SEE PHONE BOOK YELLOW PAGES

Circle **148** on Reader Service Card

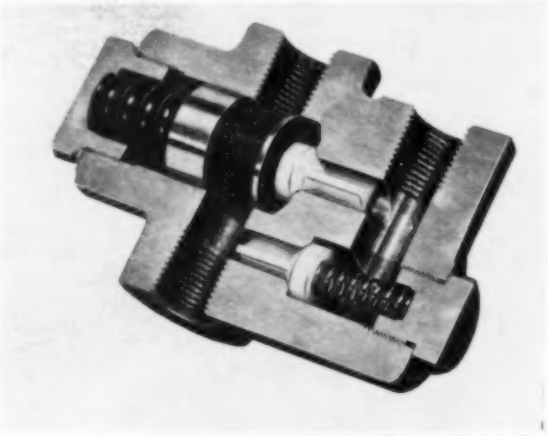
MOBILE EQUIPMENT HYDRAULICS

Continued from page 85

times called a flow regulator or priority valve. The flow having priority may be fixed or adjustable. These valves are often used to assure that a portion of pump flow is directed to the power steering or power brake circuit. The remainder may be used for load manipulation. The regulator for this application must be a combination restrictive and bypass type.

Courtesy Fawick Hydraulic—Electronic Div.

ADJUSTABLE FLOW DIVIDER locks in a set position. It directs a set flow to one circuit and bypasses the excess flow to tank or another circuit. One use for this valve is to operate fluid motors at a set speed regardless load or pressure.



Courtesy Webster Electric Co.

LOCK VALVE prevents creep in cylinders caused by leakage in directional control valves. Integral check valve prevents back flow through the valve. Line pressure opens the main valve when the directional control valve shifts to lower the cylinder.

● **Lock Valves**—In a hydraulic system where a load must be held without creep with the control valve centered, a lock valve or holding valve is used in the cylinder line. These valves are similar to counterbalance valves. They allow free flow in one direction and block flow in the other direction until line pressure reaches a set value. They are often used to support overhanging booms. ▼▼▼

Save on material cost
Save on machining

Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing

the tubing that can often be delivered as a finished part

Precision controlled wall thickness with uniform concentricity makes ELECTRUNITE Special Smooth I.D. a finished part ready for use without machining in many applications.

Because you can order ELECTRUNITE in exacting wall thicknesses, there's no need to pay for extra metal which may ultimately be machined away.

Only selected quality flat rolled steel is used in making ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing. Thickness of this steel is precisely controlled in rolling, assuring uniform wall thickness of the finished tube.

All tubing is welded by the exclusive ELECTRUNITE process *without addition of extra metal*, assuring that the weld area is of the same chemistry as the rest of the tube. In the processing, lengths of tubing are normalized in a controlled atmosphere furnace, completely recrystallizing the weld area to provide a uniformly ductile tube.

Tubing is drawn through a ring die and over a highly polished mandrel, attaining exacting I.D. and O.D. tolerances as well as a dense I.D. surface finish.

Standard I.D. tolerances are closer than those shown for tubing made by other processes. When necessary, tolerances can be maintained to 50% closer than standard.

For full information on Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing, Republic Hydraulic Fluid Line and Mechanical Tubing contact your Republic representative or write direct.

Strong, Modern, Dependable

REPUBLIC STEEL
STEEL AND TUBES DIVISION
Cleveland 8, Ohio
REPUBLIC HAS THE FEEL FOR MODERN STEEL

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • DEPT. A-2498
211 EAST 131st STREET • CLEVELAND 8, OHIO

Please send more information on Republic ELECTRUNITE® Special Smooth I.D. Hydraulic Cylinder Tubing.

Name _____ Title _____

Firm _____

Address _____

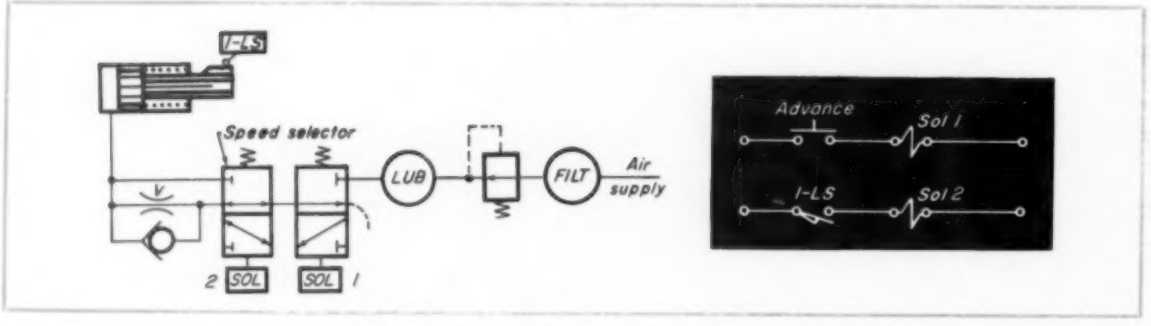
City _____ Zone ____ State _____

Circle **140** on Reader Service Card

Two air circuits for cylinder speed control

• By **W. C. THOMPSON,** *Product Sales Manager, Air Valve & Crown Div., Hannifin Co. Division Parker-Hannifin Corporation, Des Plaines, Illinois*

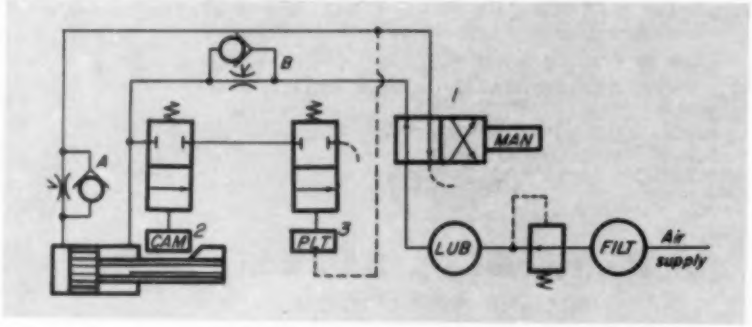
In many air circuits, cylinder speed is controlled only during part of the stroke. To speed up cycle time, the cylinder must move fast during the part of the stroke when speed is not regulated. Here are two circuits which give fast cylinder starts.



METER-IN control shown in this single-acting cylinder circuit may be used where smoothness of rod movement is not critical.

Cylinder starts fast by bypassing the flow control valve. Limit switch 1-LS is closed when the cylinder retracts. This limit switch energizes solenoid valve 2. When the ADVANCE pushbutton is depressed, solenoid valve 1 is energized. This valve shifts applying air to the cylinder, bypassing the flow control valve. The cylinder advances rapidly until the cam rides off the limit switch, de-energizing solenoid valve 2. This valve shifts, directing air to the cylinder through the flow control valve which regulates speed.

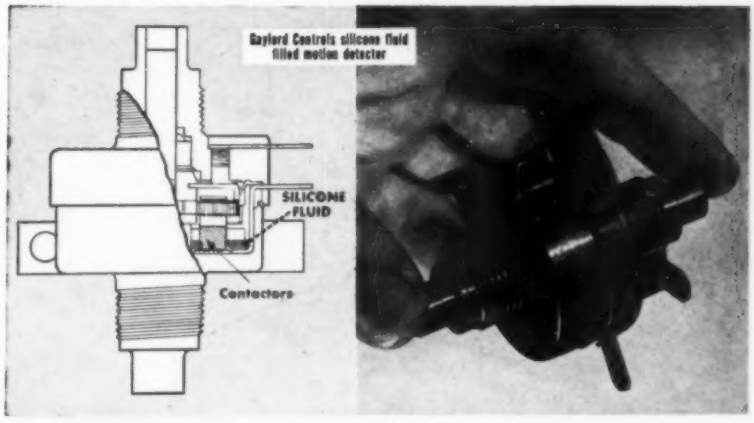
The cylinder retracts rapidly when the pushbutton is released. Air exhausts through the check valve until the cam closes limit switch 1-LS, shifting valve 2. Exhaust air then bypasses the flow control valve.

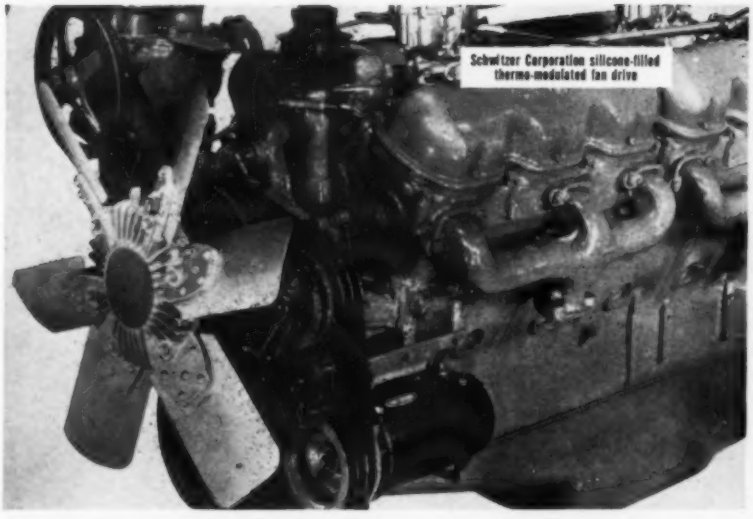


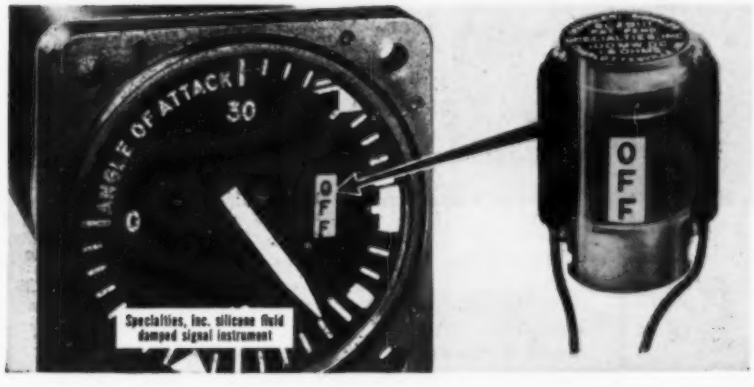
CYLINDER STARTS FAST by rapidly decreasing pressure in its head end when the control valve shifts. With the directional control valve 1 in the position shown, the cylinder retracts at a speed controlled by flow control valve *A*. With the cylinder fully retracted, cam-operated valve 2 opens. When the directional control valve 1 shifts to advance the cylinder, air is applied to the pilot of the 2-way, pilot-operated valve 3. The valve opens exhausting air from the head end of the cylinder to atmosphere. The cylinder advances rapidly until the cam rides off the cam-operated valve 2 closing the atmosphere exhaust. The remainder of the cylinder's stroke is regulated by the setting of flow control valve *B*.

SILICONE NEWS from Dow Corning

Dividend for designers



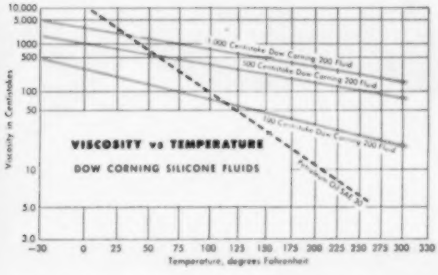




How to make your designs more versatile

Even the best device can be made more versatile, more practical, more efficient by engineering it to utilize the advantages of Dow Corning silicone fluids. Here's what these advanced engineering materials have to offer designers.

Stability to Heat, Cold. Dow Corning silicone fluids retain near-constant viscosity over wide temperature spans — help assure uniform, dependable performance in spite of temperature fluctuations. Damping effect, for example, only decreases from 3 to 1 over a temperature rise from minus 40 to plus 160 F. Under identical conditions, damping effect of a petroleum fluid decreased from 2500 to 1.



Long Life. Highly resistant to oxidation, Dow Corning silicone fluids undergo virtually no change even after long term service — are nonsludging, nongumming. Silicone fluids are inert . . . will neither corrode metals nor cause rubber to swell . . . have no harmful effect on component parts of devices or systems.

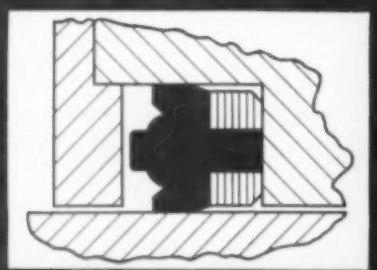
Good Compressibility. For liquid springs, shock absorbers and similar equipment, Dow Corning produces special silicone fluids that offer unusual compressibility in addition to all the other desirable properties that characterize silicone fluids. These compressible fluids make possible reductions up to 30% in oil chamber size . . . save vital weight and space.

For detailed information and technical assistance in adapting silicones to your products, address Dept. 5521, Dow Corning Corporation, Midland, Michigan.

first in silicones

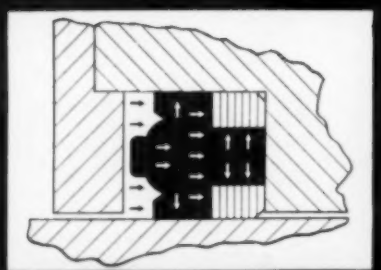
Dow Corning

TRIST SEALS



The SCN ring

(Patent No. BP 805253)



BEFORE PRESSURE IS APPLIED

SEALING UNDER PRESSURE

RONALD TRIST & CO. LTD.

(a company of the Bell's Asbestos and Engineering Group)

Bath Road, Slough, Bucks, England
Telephone: Slough 25041
Telegrams: Resvalar, Slough

The SCN-Ring, a patented design of hydraulic seal, combines the sealing efficiency of homogenous synthetic rubber seals with the resistance to wear and extrusion associated with fabric packing.

As a piston head and rod or gland seal it is effective at pressures as high as 10,000 p.s.i., and will retain "slack" oil at zero pressure. Comprehensive range of standard sizes ex stock.

Please write for Folder HP/R.28

HYDRECO
out front in . . .
PRODUCTION QUALITY CONTROL

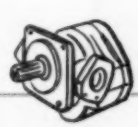
. . . JUST ONE MORE WAY HYDRECO SERVES YOU BETTER!

Modern gaging equipment — like these units for checking critical dimensions — is an important factor in the reliable quality control provided by Hydreco. Such equipment is used at every stage of the manufacturing process.

But Hydreco quality control does not stop there. To insure precision made products, master gages are also used to double check the accuracy of production gages!

This gaging equipment is just one more reason why Hydreco continues to lead in the essential areas of quality and performance. It's also one of the big reasons why — when it comes to Hydraulic equipment — more and more companies are switching to Hydreco . . . the one that serves you best.

HYDRECO® DIVISION
THE NEW YORK AIR BRAKE COMPANY
KALAMAZOO • MICHIGAN


PUMPS

VALVES

MOTORS

Circle **88** on Reader Service Card

Specify Air Power!

STOCKED FOR IMMEDIATE SHIPMENT

Use variable-speed, explosion-proof

GAST AIR MOTORS

Need a compact, low-cost motor for original equipment or plant use applications? *Air may be your answer . . .* using one of these efficient Gast rotary-vane Air Motors. Look at the special advantages they offer you:

1. They're explosion-proof — no sparks, no danger!
2. Low initial cost compared to other motors.
3. Speed variable with simple valve control.
4. Can't burn out if overloaded or stalled.
5. Reversible rotation optional on some models.
6. Rotor vanes take up their own wear.
7. Quickly attached to plant air lines.
8. Amazingly light, compact for h.p. delivered.
9. Ball-bearing; almost service-free design.
10. Mechanically simple, neat in appearance.

Gast Air Motors are supplied as original equipment on pneumatic hoists, mixers for paint and chemicals, fans, blowers, fuel hose-reel rewinders, liquid pumps, spooling machines and a host of other products. Used in explosive atmospheres and in "hot" locations to 250° F.

Model No.	1AM	2AM	4AM	6AM	8AM	16AM
H.P. at 90 P.S.I., 2000 RPM	0.13	0.57	1.1	2.0	4.0	7.0
Weight, lbs.	1½	5½	8	17	25	65

For complete performance data, write for Air Motor Bulletins. Specify models that interest you.

THEY'LL DRIVE EQUIPMENT 4 WAYS:

AIR MOTORS • VACUUM PUMPS • COMPRESSORS

GAST MANUFACTURING CORP.
P.O. BOX 117-D BENTON HARBOR, MICHIGAN

Circle 65 on Reader Service Card

Swage fittings to Teflon hose in your plant

• By G. P. KARPOVICH,
Industrial Division, Titeflex, Inc., Springfield, Mass.

PERMANENT end fittings on bulk Teflon hose can be assembled in your own plant with this hydraulic swaging machine. The machine's new progressive, draw-swaging technique makes field assembled lines of Teflon as reliable as factory-made hoses.

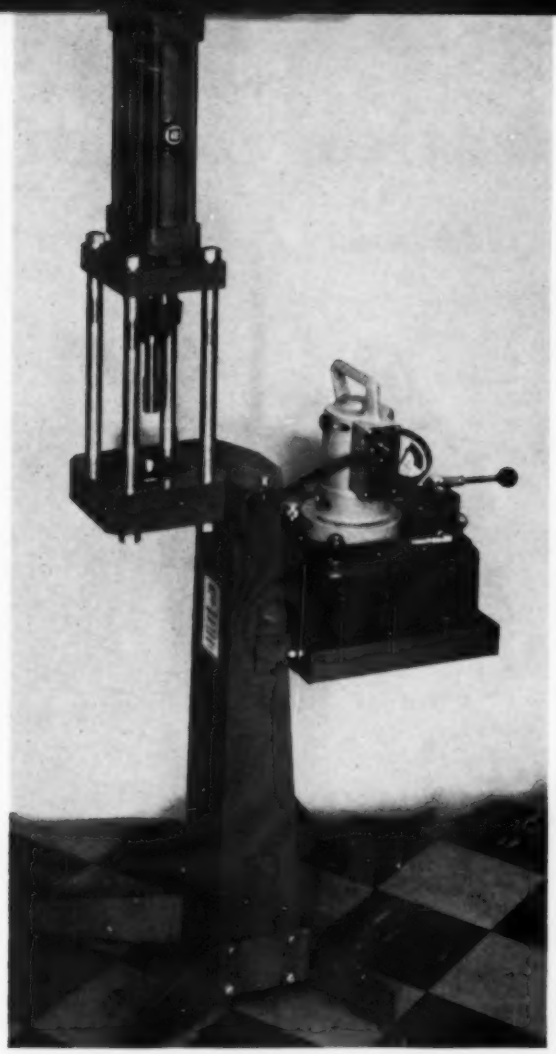
Rubber hose is commonly purchased in bulk form, cut to specific lengths, and assembled as needed. However, field assembly of Teflon is not that easy. Because of Teflon's thermal expansion, cold flow, and other unique characteristics, fitting design and attachment are more critical than for most other materials.

Most maintenance departments prefer to stock only bulk hose and fittings, making assemblies to correct length and fitting configurations as they are needed. The flexibility of being able to cut a hose to length and attach any combination of end fittings has to be balanced against the expense of the large crimping or swaging machines formerly needed to attach permanent end fittings. Ordering factory made assemblies is inconvenient and slow, especially for maintenance and mock-up or prototype work.

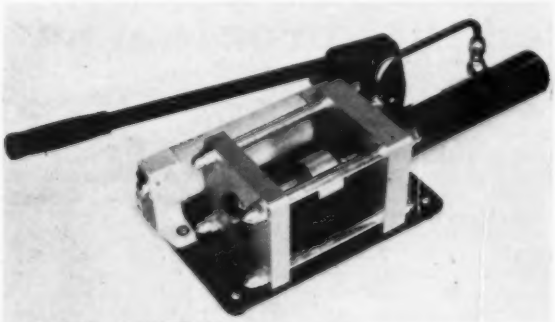
Because of these requirements, some Teflon hose manufacturers have been investigating methods of attaching permanent fittings in the field with tools of suitable design and cost. Several manufacturers now offer such equipment as illustrated.

The pedestal model hydraulic swager was designed primarily for industrial hose distributors and large users. It has interchangeable sets of dies and adaptors to handle Teflon hose of ¼ in. to 1¼ in. diameter. Fitting attachment is fast (swaging time is 15 sec), simple, and completely reliable. There are no secondary operations, and dies for different hose sizes are changed in a few minutes. If a user has a suitable press, he needs only the dies and adaptors.

The portable model of the field swager operates the same as the pedestal model and uses the same dies. A special holding fixture for the swaging dies facilitates assembly of long hose lengths and elbows as well as other types of end fittings. It is hand operated and weighs about 30 lb. It is also intended for field maintenance work and for those who do not have



MOTOR DRIVEN, PEDESTAL MODEL HYDRAULIC SWAGER of 20-ton capacity assembles Teflon hose and permanent fittings for industrial applications.



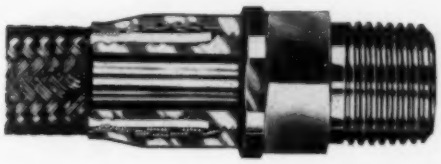
PORTABLE MODEL OF THE SWAGER is hand operated and weighs about 30 lb. The tool and die design is identical to that of the pedestal model.

the quantity requirements necessary to justify a motor driven unit. A third version of this swaging tool has a modified base plate that makes it easy to handle elbow and flange fittings and other special end fitting configurations commonly used in the aircraft and missile fields.

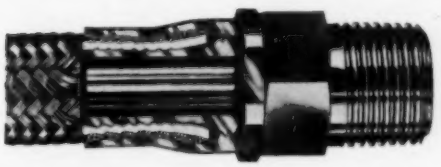
Fitting assembly in the three swager models is identical. Fittings are slipped over the ends of the hose and inserted into the machine by removing one section of the die. The die is replaced and the hydraulic ram forces the fitting down into the die cavity. This reduces the collar diameter uniformly, locking the hose and fitting into a permanent, leak-proof assembly. Performance ratings are the same for assemblies made with these tools as for those made with factory type machines.

The swagers can also be used to assemble a new type of non-skive *rubber* hose. Sizes range from ¼ in. to 2 in. diameter, and fittings include male pipe, JIC, and SAE swivel configurations, with adaptors to meet other installation requirements. Pressure ratings are to 5000 psi. ▼▼▼

PROGRESSIVE DRAW-SWAGING TECHNIQUE

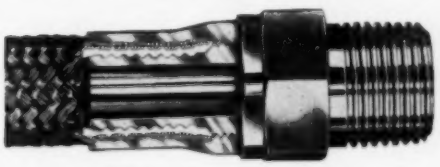


The first step for attaching permanent end fittings is to lock a predetermined volume of Teflon and braid within the fitting. This is important because it makes possible accurate control of the amount of squeeze that will be put on the plastic innercore. Too much squeeze on the innercore produces a fitting that does not have good



temperature cycling properties. Too little squeeze will not give proper braid holding power or fluid sealing force.

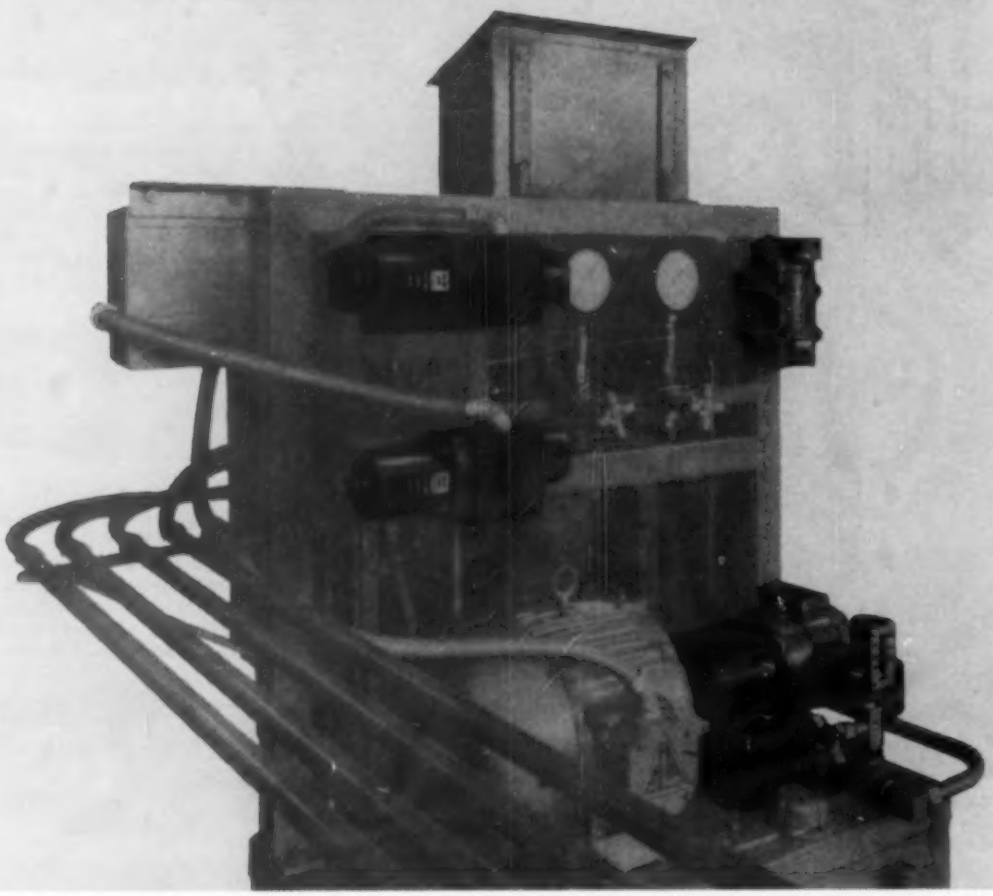
A fitting after it has been progressively swaged for about half its length. As the innercore and braids are being reduced in diameter, they are flowed forward toward the end of the fitting and also locked into



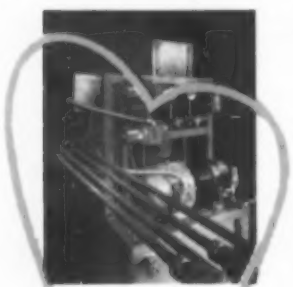
grooves in the fitting collar and insert.

The finished assembly shows how the entire cavity has been filled. There is accurate and complete sealing and locking over the entire fitting length. Total swaging time is less than 15 sec. This progressive draw-swaging technique is the same for pedestal, portable, and aircraft models.

Is hydraulic vibration one of your design problems?



Scans Associates solved this problem with a Racine Hydraulic System



Porosity testing machines manufactured for major Detroit transmission plant by Scans Associates, Livonia, Michigan.

"It would take an Act of Congress to make us use any equipment except Racine components for our porosity testing machines," says Mr. Vernon G. Converse, President of Scans Associates, Livonia, Michigan. The machine — which makes 4 different leakage tests on transmission cases in a 20-second cycle — must check porosity to ¼ inch of water pressure. The machine hydraulically clamps the part firmly in place and tightly plugs all openings. Air pressure and vacuum are alternately applied inside the part, and changes in pressure are pneumatically measured. The slightest hydraulic vibration would distort the readings. "This demands hydraulic equipment that is both extremely sensitive and steady," states Mr. Converse. "Racine has always met both requirements perfectly." The Racine system in this application consists of a Model S variable volume pump, a self-contained 30-gallon reservoir, a 5HP motor and 3 Racine valves (one of them for pressure reduction).

If your application demands sensitivity and precision in hydraulic control, a compact Racine system can meet your requirements.

RACINE HYDRAULICS & MACHINERY, INC. RACINE, WISCONSIN

We're interested in knowing more about Racine Hydraulic Systems. The application of interest to us is _____

NAME _____ TITLE _____

FIRM _____

ADDRESS _____

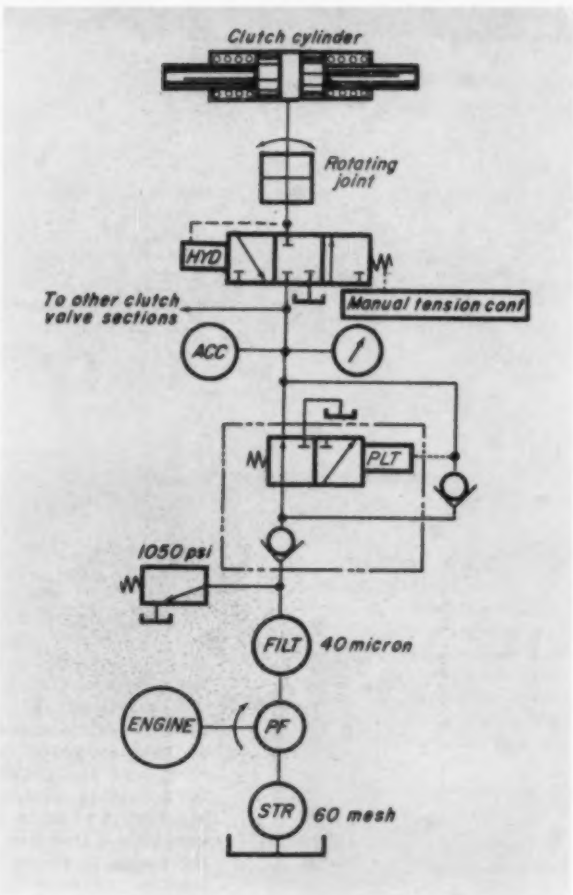
CITY & ZONE _____ STATE _____

RACINE

RACINE
designs systems
to solve hydraulic problems

Component designs for shovel's clutch system

• By **PAUL A. CHALUPSKY,**
Supervising Engineer, Hydraulics,
Link-Belt Speeder Corp., Cedar Rapids, Iowa



Standard and special components are combined in this constant pressure accumulator system to give the operator fine enough control to slip the clutches.

THIS system gives the operator the constant pressure he needs for fine clutch control. The system is very efficient because with an accumulator in the circuit the pump works against pressure less than 10% of the time. The system relief valve is set at 1250 psi. It acts as a safety valve, and bypasses fluid if the unloading valve fails to function properly.

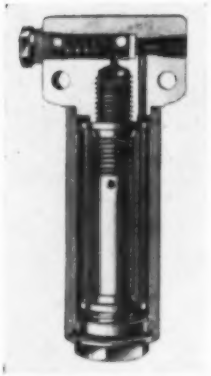
The hydraulic system has an operating pressure range between 900 and 1050 psi. When the accumulator is charged to 1050 psi, the unloading valve unloads the pump to reservoir at near zero pressure. When the pressure drops to 900 psi, the system is recharged to 1050 psi, and the pump is again unloaded.

The oil used in this system is a high quality mineral turbine oil with a paraffin base, 180 SSU at 100 F. Heavier oils are used to lessen internal leakage on older machines or slightly worn components.

COMPONENT DESIGNS

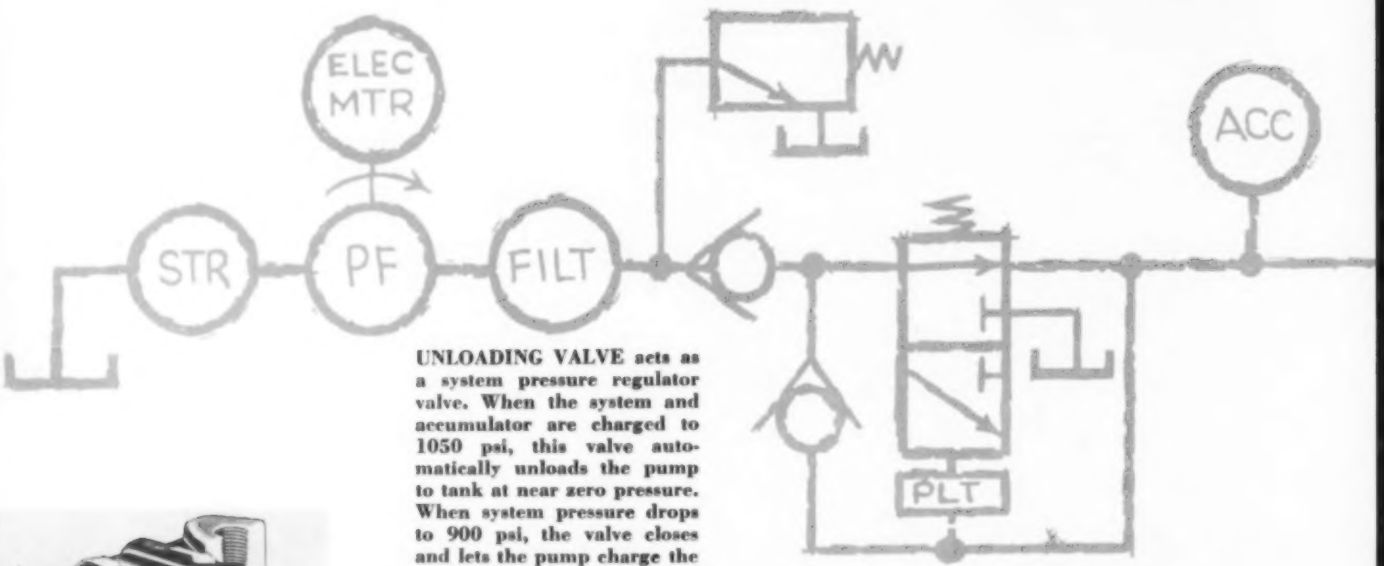
Extreme temperature fluctuations make it desirable to use an oil that is resistant to visocity changes. A viscosity index of at least 90 is recommended. Though the oil found most satisfactory is not of the low pour point type, in sub-zero weather the oil flows more readily and with less pump cavitation than many other hydraulic oils. Field experience shows that such oil flows easier, even when slightly congealed, than many products in the fluid stage.

Rapid temperature changes cause water to condense in the reservoir and therefore, the oil must resist emulsification. An oil that does not resist emulsification and lacks chemical stability, will form gums and cause corrosion, resulting in poor component performance.

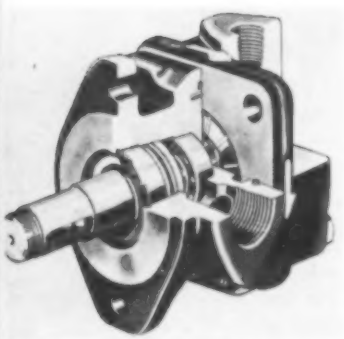


HIGH-PRESSURE, FULL-FLOW FILTER is connected to pressure side of the pump. The filter has an integral by-pass valve which allows through-flow in case of restriction. A ribbon-type filtering element provides 40-micron filtration.

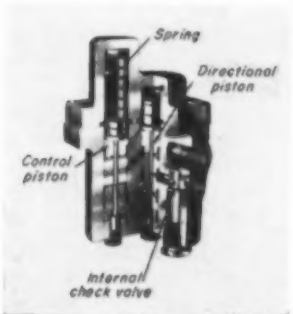
RELIEF VALVE protects the system if the unloading valve fails to open after the accumulator has been charged. The relief valve is a spring-loaded, guided-spool type. It is set to relieve at 1250 psi by adding or removing shims between the valve cap and the valve spring.

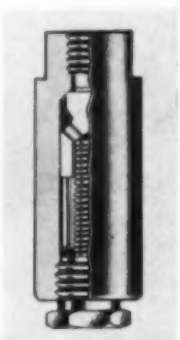


UNLOADING VALVE acts as a system pressure regulator valve. When the system and accumulator are charged to 1050 psi, this valve automatically unloads the pump to tank at near zero pressure. When system pressure drops to 900 psi, the valve closes and lets the pump charge the system. The 150-psi range between opening and closing cannot be changed, because it is controlled by the relative positions of machined lands on the control spool and machined ports in the control spool liner. However, the loading and unloading pressures can be changed together by shimming the valve.

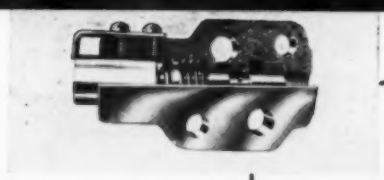


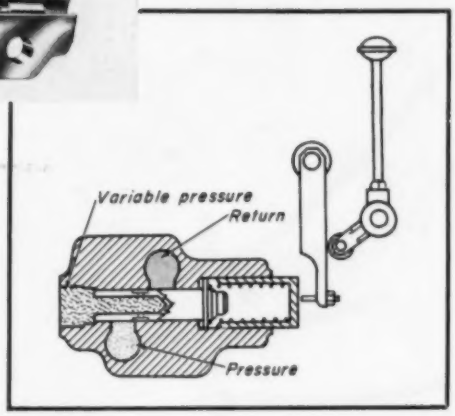
FIVE-GPM VANE PUMP is belt-driven from engine crankshaft. Pump speed can be varied from 400 to 2200 rpm depending on engine speed.



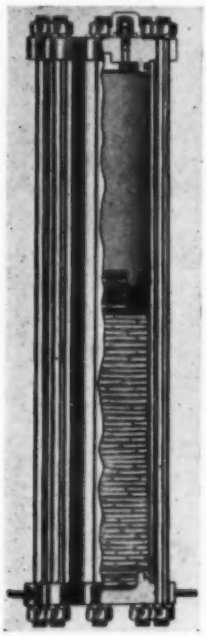


EXTERNAL CHECK VALVE also holds the pressure charge in the accumulator. Its main function is to compensate for variations (in oil, temperature, or engine speed) which can cause the pistons in the unloading valve to stop in a neutral position, which would block free flow from the pump to the accumulator or reservoir. The check valve lets oil by-pass the unloading valve through a secondary line to the accumulator. When pressure builds up in the accumulator and unloading valve, it forces the unloading valve pistons out of their neutral position, and the unloading valve resumes normal operation.





GAS-OIL ACCUMULATOR is made of a steel tube, whose ends are closed with steel, O-ring sealed caps. Eight tie-rods hold the assembly. The accumulator acts as a pressure supply tank while the unloading valve unloads the pump to reservoir. Gas and oil are kept separated by an O-ring sealed piston which travels up and down inside the accumulator cylinder as system pressure fluctuates. A valve at the top of the accumulator chamber is used to charge and check the nitrogen pressure at 650-psi precharge.



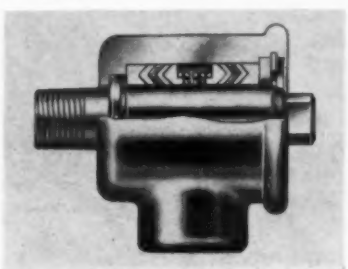
DIRECTIONAL CONTROL VALVE is 3-way, variable pressure, closed center and actuates the system's friction clutches together or independently. Valve sections are assembled in a manifold which distributes oil to the various cylinder at pressures proportional to the movement of the individual valve control levers.

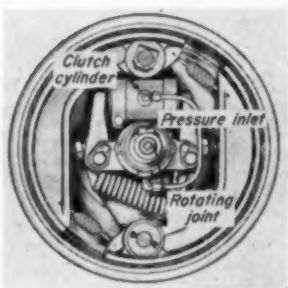
This action is almost instantaneous. When the operator actuates the control lever, he compresses the spool spring, which pushes the floating spool and connects the cylinder port to system pressure. Oil extends the two clutch cylinder pistons against the clutch spring. When oil pressure balances the spool spring force, the spool centers cutting off fluid. The clutch will remain in position as long as the operator does not move the control lever. If he pulls the lever back a little more, the clutch pistons will extend proportionally. This gives the operator very fine control, and lets him slip the clutches if required. When the operator releases the control lever, the spool spring force drops to zero, oil pressure shifts the spool and connects the cylinder line to tank.

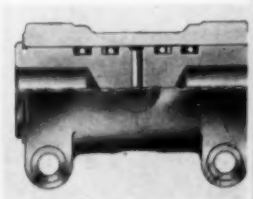
Each section can control and maintain pressures in infinite increments from zero to 650 psi after which any additional lever movement will give full system pressure. Valve sections are connected in parallel so that any number can be actuated simultaneously at varying pressures without affecting or interfering with the operation of any other section.

PRESSURE GAUGE is near operator and normally records 900 to 1050 psi working pressure. In case the unloading valve fails to open, the gauge jumps to 1250 psi, alerting the operator of system malfunction.

ROTATING JOINT to the clutch transfers fluid from a stationary tube to a rotating shaft. The stem of the joint is screwed into a revolving end-cap; the body is attached to the stationary tube. The rotating joint is sealed with non-adjustable, spring-loaded, V-packing between the stationary housing and the rotating shaft.







CLUTCH ACTUATING CYLINDERS have twin, single-acting, spring-returned pistons. Hydraulic pressure to a cylinder extends the pistons together in opposite directions against the force of a common returning spring. Each piston has one pressure-sealing O-ring and two back-up washers in the same groove. Both back-up washers are opposite the pressure side of the pressure sealing ring. A split O-ring in a second groove acts as a wiper to keep foreign particles from entering the pressure sealing grooves.

The Purolator P32 Micronic® Filter makes short work of hydraulic system dirt. Stops it – before it gets a chance to wreck equipment and rob you of top efficiency and output. Here's how it works:

Greater filtering area. The Micronic® Filter is a resin-impregnated cellulose element that traps contaminants, leaving vital hydraulic systems clean. It is specially preformed and pleated for maximum filtering area.

Easy element change. The clamp-lock ring construction lets you change elements without disconnecting the filter unit from the system. Just unscrew the couplings, throw away the dirty element – and slip in the replacement.

Adaptable application. You can use one or two elements, whatever you need, and install units on either the pressure or suction side of the pump. The unit can withstand operating pressure up to 300 lbs.

The P32 series is a medium size line ranging in flow capacity from 15 to 30 GPM. It is 1 of over 2000 units available from Purolator, the world's most experienced filter manufacturer. For information, write: Purolator Products, Inc., Rahway. New Jersey.

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, CANADA

Circle **134** on Reader Service Card

KEELAVITE
Hydraulics

HYDRAULIC POWER PACKS

IN THEIR NEATEST FORM

THE 'MIDGET'
THE 'MINOR'
THE 'MAJOR'
THE 'MIGHTY'

Keelavite power packs provide a range of self-contained hydraulic power units suitable for many widely differing industrial applications. A large number of pumping capacities are available. All packs are so designed that the valves most suitable for the customer's requirements can be fitted. Standard units from the enormous Keelavite range are used.

KEELAVITE POWER PACKS ARE ESPECIALLY USEFUL—

. . . When you require a mobile hydraulic power unit. A caster mounted pack is ideal for operating a battery of hydraulic jigs and tools intermittently.

. . . when installing a remote control system. The pack may be located at a distance from the operated mechanism, particularly useful where explosive atmospheres are encountered.

. . . when size and weight restrictions are imposed. Mount the pack alongside the machine and just couple up to the actuators.

Name	Dimensions: less height of motor	Tank Capacity	Electric Motor H.P.	Pump Capacities
The MIDGET	18"x12"x18"	7½ gall.	up to 2	To suit customer's requirements
The MINOR	30"x16"x16½"	20 gall.	up to 5	
The MAJOR	40"x24"x16½"	50 gall.	up to 12½	
The MIGHTY	40"x24"x24"	75 gall.	up to 25	

introducing an entirely new
Power Pack of which you will want details

The KEELAPACK

A desk top console which houses the complete hydraulic system. Hydraulic and electrical controls neatly contained in minimum space. Custom built from standard components.

For full details write to

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD
ALLESLEY • COVENTRY • ENGLAND • TEL: MERIDEN 441

EUROPEAN REPRESENTATIVE
Mr. T. P. Keeling
Keelavite Hydraulics Ltd.,
Pieter de Hoochstaat 17
Rotterdam 6, Holland

KEELAVITE COMPLETE HYDRAULICS
— a complete range of units
— thirty years of hydraulic experience
— and a service that means success

615 Cogent

Circle **97** on Reader Service Card

BREAKTHROUGH!

New Precision "O" Ring Development Cracks A Service Barrier

Two new Precision Compounds*, both gamma radiation resistant to maximum total dosage of 1 x 10^9 roentgens, open up new horizons of sealing in nuclear systems. They cover a wide range of fluid applications. This major scientific development extends Precision leadership in the development and production of "O" rings.

The quality of **all** Precision "O" Rings, whether produced for nuclear service or standard industrial use, is a matter of recognition and record. In your product, that quality protects the high performance standards you set for it . . . preserves reliability and reputation. Be sure you have the **right** "O" ring for your product, made from the **right** compound by specifying Precision. Call for the services of a Precision engineer today.

*** Complete engineering data on these new compounds – 1387 and 4387 – available on request. Ask for bulletin in No. 5041**

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 17, Ohio **Canadian plant at: Ste. Thèrése de Blainville, Québec**

REQUIREMENTS FOR REMOVING WATER

The amount of water-vapor a gas can hold depends on the temperature of the gas. When the ideal gas law is applied to water vapor:

$$\frac{W_o}{V} = \frac{P_o}{ST_o}$$

where $\frac{W_o}{V}$ = Saturation moisture content in weght moisture/unit volume, lb/ft³

P_o = Saturation vapor pressure at T_o, lb/ft²

S = Water vapor constant, ft lb/lb °R

T_o = Ambient temperature, °R

Note that any given temperature $\frac{W_o}{V}$ is constant.

Relative humidity R_h is the ratio of the actual weight of moisture per unit volume to the saturation weight of moisture per unit volume.

$$R_h = \frac{W/V_1}{W_o/V_1} = \frac{W}{W_o} \text{ in a given volume}$$

Dehydrating high pressure gas

• By **STUART M. SACHS***, *Consulting Engineer, Far Rockaway, N.Y.*

Water vapor in a pneumatic system can cause a lot of trouble. It can freeze lines, corrode components, and form sludge. To avoid such difficulties, the gas must be dehydrated.

TO DEHYDRATE a gas it is first cooled. Water condenses and droplets of water (and oil) are filtered out. The gas leaves the filter and passes an oil remover which removes oil vapor. The gas is then ready to flow into a dehydrator which will remove remaining water vapor and make the gas completely dry. A typical compressor-dehydration system is shown in Figure 1.

• **Dehydrator Design and Operation**—A dehydrator system has towers, flow control valves, a heater, a pressure switch, and sometimes an auxiliary compressor. The tower contains an adsorbent material (desiccant) such as silica gel, or a molecular sieve. As the gas passes through, the desiccant dries it. Dry gas leaves the dehydrator and flows to a storage tank.

A properly designed tower has an output humidity equivalent to about —100 F dewpoint. For a higher degree of dehydration, it is necessary to use refrigeration drying methods. Most applications require instrument dryness of zero to —40 F dewpoint. Some missile and aircraft systems require —65 F dewpoint. Cryogenic applications need still dryer gases.

A saturated desiccant stops adsorbing water, and must be reactivated. Passing a stream of hot (300 to 400 F) dry gas over the adsorbent material desorbs it. After reactivation, and before using it again, care must be taken to cool the tower completely.

Continued on next page

*Mr. Sachs was with Greer Hydraulics, Inc., when this article was written.

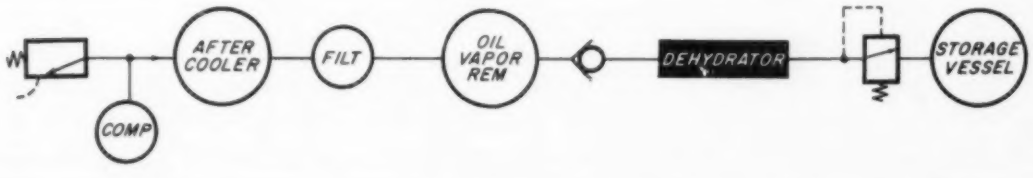


FIG. 1. CIRCUIT shows path a gas follows from compressor to storage tanks. Dry gas is stored in receiver vessel.

DEHYDRATING HIGH-PRESSURE GAS

• **Manual Dehydrators**—Dehydrators are either manual or automatic. Manual units have only one tower. When the desiccant is saturated, it is removed and reactivated in an oven. Automatic dehydrators have two towers. One continues to dry the gas while the other reactivates the desiccant. A manual, single-tower dehydrator, Figure 2, can be used satisfactorily where manpower is readily available, low flow of gas is required, and the dehydrator needs to operate only part of the time. Some single tower dehydrators have removable desiccants. When the adsorbent charge is saturated, it is removed, and replaced with a reactivated one. The saturated charge is put in an auxiliary oven for reactivating. Manual dehydrators are well suited for jobs where they are in service less than half the time.

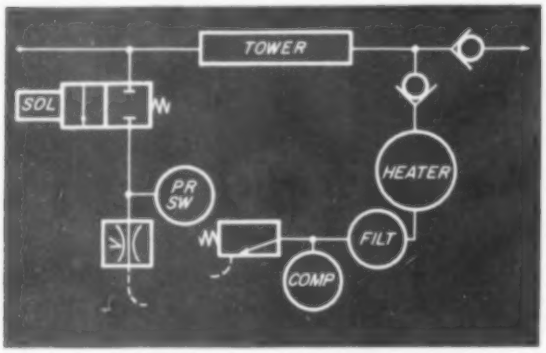


FIG. 2. SINGLE TOWER, manual dehydrator is economical and recommended where dehydrator operates less than half the time.

• **Automatic Dehydrators**—These are divided into two classes:low pressure (up to 150 psig) and high pressure (over 150 psig). Use automatic dehydrators where:

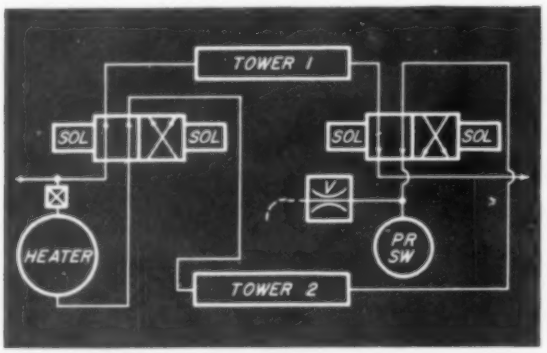


FIG. 3. LOW PRESSURE AUTOMATIC DEHYDRATOR diverts part of compressed gas to heater. Hot gas is used for reactivation cycle.

- There is a shortage of manpower
- Separate reactivation ovens are impractical
- Great care in handling is required
- High flow rates are needed
- The equipment make a more economical installation

• **Low Pressure Systems**—The circuit in Figure 3 diverts some compressor air, heats it, and uses it for reactivation. One tower is always in use while the other is either reactivating or cooling. Should a sole-

Continued on page 116

Water Vapor and Hydrocarbon Content Conversion Table

From PPM/W to PPM/V & Vice Versa of H_2O & HC to C_1 to C_6 in Various Parent Gases

FORMULAS:

$$PPM/W = \frac{PPM/V \times \text{Mol. Wt. Impurity}}{\text{Mol. Wt. Parent Gas}} = A$$

$$PPM/V = \frac{PPM/W \times \text{Mol. Wt. Parent Gas}}{\text{Mol. Wt. Impurity}} = B$$

CARBON	= 12 Mol. Wt.	=	12 Atomic Wt.
HYDROGEN	= 2 Mol. Wt.	=	1 Atomic Wt.
HELIUM	= 4 Mol. Wt.	=	4 Atomic Wt.
NITROGEN	= 28 Mol. Wt.	=	14 Atomic Wt.
OXYGEN	= 32 Mol. Wt.	=	16 Atomic Wt.

ONE PPM/V AS		Mol. Wt.	Mol. Size A° (Angstroms)	(A) EQUIVALENT PPM/W IN PARENT GAS				
				Air(29)	Helium(4) 2.6x2.6x4.0	Hydrogen(2) 2.4x2.4x3.0	Oxygen(32) 2.8x2.8x3.8	Nitrogen(28) 3.0x3.0x4.09
Water	H_2O	18		.62	4.5	9.0	.56	.64
Methane	CH_4	16	4.00x4.00x4.00	.55	4.0	8.0	.50	.57
Ethane	C_2H_6	30	4.00x4.00x5.54	1.03	7.5	15.0	.94	1.07
Propane	C_3H_8	44	4.89x4.00x6.52	1.51	11.0	22.0	1.37	1.57
Butane	C_4H_{10}	58	4.89x4.00x7.78	2.00	14.5	29.0	1.81	2.07
Pentane	C_5H_{12}	72	4.89x4.00x9.04	2.48	18.0	36.0	2.25	2.57
Hexane	C_6H_{14}	86	4.89x4.00x10.34	2.96	21.5	43.0	2.68	3.07

ONE PPM/W AS		Mol. Wt.	Mol. Size A° (Angstroms)	(B) EQUIVALENT PPM/V IN PARENT GAS				
				Air(29)	Helium(4) 2.6x2.6x4.0	Hydrogen(2) 2.4x2.4x3.0	Oxygen(32) 2.8x2.8x3.8	Nitrogen(28) 3.0x3.0x4.09
Water	H_2O	18		1.61	.222	.111	1.77	1.55
Methane	CH_4	16	4.00x4.00x4.00	1.81	.25	.130	2.00	1.75
Ethane	C_2H_6	30	4.00x4.00x5.54	.97	.13	.067	1.07	.93
Propane	C_3H_8	44	4.89x4.00x6.52	.66	.09	.046	.73	.64
Butane	C_4H_{10}	58	4.89x4.00x7.78	.50	.069	.034	.55	.48
Pentane	C_5H_{12}	72	4.89x4.00x9.04	.40	.055	.028	.44	.39
Hexane	C_6H_{14}	86	4.89x4.00x10.34	.34	.046	.023	.37	.33

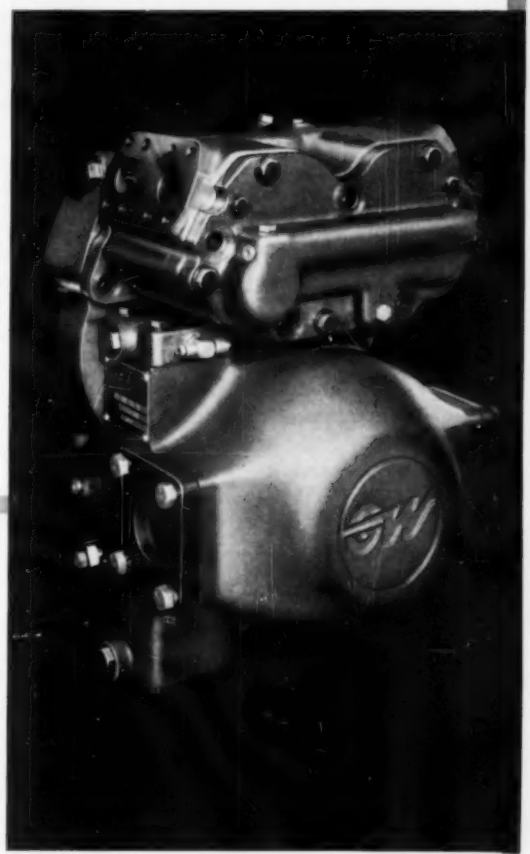
Parts per million by volume (ppm/v) or parts per million by weight (ppm/w) are terms commonly used. With ppm/v a reference to a hydrocarbon (such as hexane) must also be made to indicate an absolute amount when refering to oil vapor. The parent gas should be identified in both cases. For example, 1 ppm/v or 1 ppm/w will vary in absolute quantity depending on whether the parent gas is nitrogen or hydrogen. The reason for this is the molecular weight difference of these gases.

Information for table supplied by Robbins Aviation, Inc.

Gar Wood Industries, for 50 years leaders in the manufacture of tractor and truck hydraulic equipment, announces the formation of its new

HYDRAULIC DIVISION

marketing hydraulic components, including hydraulic pumps, motors, hydrostatic transmissions and the revolutionary . . .



VARIACS

VARIABLE VOLUME PISTON PUMP

Variacs represents a new concept in hydraulics—a pump that delivers oil only on demand, only in the volume required. With capacities up to 250 gpm, there is a Variacs to do any job more efficiently. Here's a pump that eliminates horsepower waste, insures longer life and greatly minimizes the heat problem inherent in all conventional hydraulic systems. Variacs makes possible today's only successful hydrostatic drive.

Gar Wood's technical team of hydraulic specialists is ready to work with you on any project, program or problem involving industrial or mobile hydraulics and hydraulic systems. Take advantage of the experience, ability and the proven products offered by this group—the Hydraulic Division of Gar Wood Industries, Inc.

GAR WOOD INDUSTRIES, INC.

Hydraulic Division

Wayne, Michigan

See the Variacs Variable Volume Piston Pump in Booth A-1, S.A.E. Convention, Milwaukee, Wisconsin, September 11th to 14th, 1961.

Circle **62** on Reader Service Card

noid valve fail, hot, low-pressure or saturated gas would flow into the tower. This is annoying, but otherwise of little consequence.

• **High Pressure Systems**—An auxiliary compressor is used in the circuit of Figure 4 to supply reactivation air. There are two reasons for using a second compressor instead of the system's high-pressure gas:

- It is dangerous to expose the tower to both the high temperature and the high pressure required during reactivation.
- It is expensive to use system air for reactivation because it would be necessary to specify a compressor large enough to supply gas to both the working tower and the reactivating circuit. The use and cost of such a large compressor is not warranted. The auxiliary compressor does the job equally well, and the entire installation is more economical.

Should a solenoid fail to work, either the compressor relief valve would relieve, or the reactivation circuit valve solenoids would not be energized. Either is bothersome, but not harmful.

• **Tower Protection**—In all three dehydrator systems, the heater is interconnected to a pressure switch. Air must flow before the heater will turn on. A variable flow control valve upstream from the heater controls the pressure of the gas to be heated, and protects the tower from over pressure at high temperatures.

A high pressure system should also have a rupture disk to further protect the tower. The rupture disk feels pressure but not tower temperature when it is connected in the circuit at the end of a long static leg. ▼▼▼

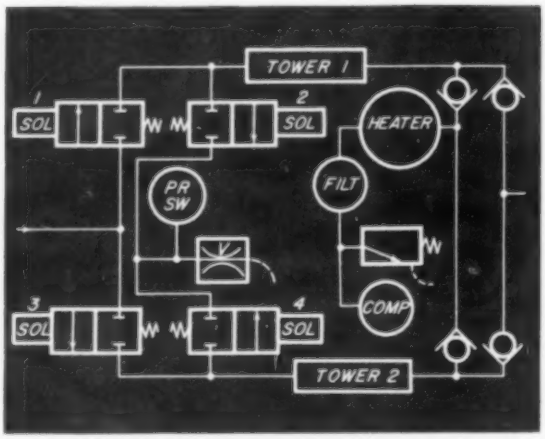


FIG. 4. HIGH PRESSURE AUTOMATIC DEHYDRATOR has auxiliary, oil-free compressor to supply reactivation gas to tower desiccant.

Principles of gas purification

• By J. R. CLARK, JR., *Chief Engineer, Robbins Aviation, Inc., Los Angeles, California*

THERE IS MOISTURE in all gases. When it is mixed with a gas it is called water vapor. The amount of water vapor a gas can hold depends on the pressure and temperature of the gas and on how much the gas has been exposed to moisture. High temperature gases retain more water; high pressure gases pick up the least water.

At a given temperature and pressure a gas has a certain capacity to hold water. When this capacity is reached, the gas is saturated. If the temperature of the gas is decreased, or the pressure increased, the amount of water the gas can hold is decreased, and the excess water precipitates. The gas, at the new temperature and pressure, is still saturated, but a definite quantity of water has been given up and the amount of water that the gas now contains is smaller.

In some instances a gas may carry less water than its capacity. The water vapor content is then called relative humidity (or the percent of the amount of water in the gas to the amount the gas could hold if it were saturated at that particular temperature and pressure).

Gases exposed to oil will also pick up and carry oil vapor. When oil vapor content in a gas is specified, it should be stated in parts per million by weight.

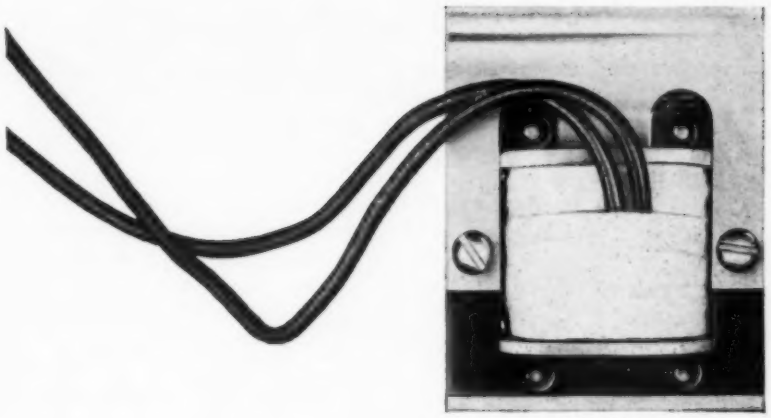
MOISTURE REMOVAL METHODS

In dynamic dehydration and purification a gas can be processed with one of three methods: mechanical, chemical, or adsorptive.

• **Mechanical Dehydration**—Entrained liquids are usually removed by filtering or centrifugal action. The oil or water vapors are reduced by decreasing the temperature and/or increasing the pressure. The condensed vapors are then drained off as a liquid. Temperatures below 32°F. are not practical because of icing conditions.

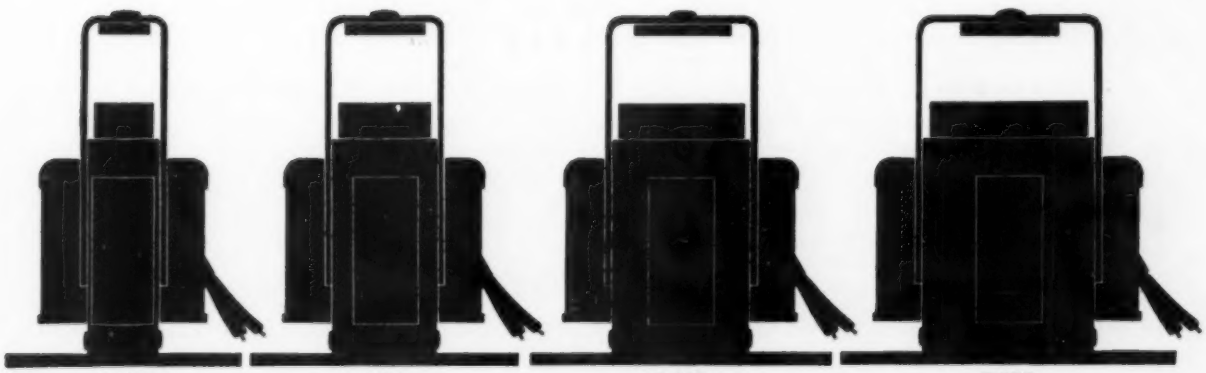
• **Chemical Dehydration**—This process uses reactive materials, such as phosphorous pentoxide,

Continued on page 118



actual size

Single Purpose Solenoid ... National Acme's "T" New T Type



T-APR T-BPR T-CPR T-DPR

(Silhouettes . . . 85% actual size. Push range up to eight pounds at ½" stroke.)

National Acme's new "T" Type solenoid is designed specifically and solely for hydraulic and pneumatic valve applications . . . proved by months of exhaustive testing by leading valve manufacturers. As you can see, there are four sizes offering a push range of two to eight pounds with up to a half inch stroke. The "T" Type is available with push pins of various lengths and diameters (captive or loose), and either a standard bobbin or epoxy molded coil. Get full details. Check with any of our nationwide staff of sales engineers, or, get in touch with us here in Cleveland. We'll look forward to hearing from you.

ELECTRICAL CONTROLS DIVISION

National Acme

THE NATIONAL ACME COMPANY
184 E. 131st STREET
CLEVELAND 8, OHIO

SALES ENGINEERS IN PRINCIPAL CITIES

ascarite, and others which combine chemically with the water or substance to be removed. Closely allied to the chemical processes are those using hygroscopic (moisture-retentive) materials, such as calcium chloride, glycerine, sugar syrup and glycols which take the vapors into solution. These processes are difficult to handle in industrial equipment as most drying agents are liquid or become liquid during use. Many of them are also corrosive.

• **Adsorptive Dehydration**—This method uses carefully selected adsorption agents called desiccants. These solid materials have a very large surface area per unit volume. They are chemically inert, undergo no change in physical state while in use, require no extreme pressures or temperatures, and can be dried or reactivated for further use. They have none of the limitations of the other processes. Each pound of desiccant has over 2,000,000 square feet of area available for adsorbing.

• **Attaining Specific Dewpoints**—With higher pressure gas it is easier to obtain a low dewpoint, as the moisture carrying capacity of the gas is less. Adsorption type dehydration can produce dewpoints as low as —100 F measured at atmospheric pressure. When necessary, —120 F dewpoint can be obtained at low gas temperature and high pressure. Refrigeration type dehydration can theoretically produce dewpoints to —180 F at operating pressure using liquid nitrogen or other liquid gases, but icing conditions create additional problems. In large volume applications, refrigeration and adsorption methods are sometimes combined to obtain dewpoints in the —70 F to —120 F range without going below the freezing point of water. This eliminates the need to defrost.

• **Back Pressure Valve**—A back pressure valve should always be installed immediately downstream from the dehydration and purification equipment. It maintains a predetermined minimum pressure in the purification system. This pressure should be at least 75% of the pressure of the upstream gas to insure that the maximum amount of water and oil will condense from the gas before it enters the desiccant material. Maintaining this pressure in the systems also controls gas flow velocity and avoids possible damage to the desiccant. To avoid overloading the gas compressor, the back pressure valve should be flow rated at least as high as the compressor is rated at the operating pressure. ▼▼▼

GLOSSARY OF GAS TERMS

ADSORPTION—The attraction and retention of a vapor or liquid to the surface area *only* of the adsorptive material molecules (opposite of absorption).

ANGSTROM—One ten thousandth of a micron; four billionths of an inch. Used to express molecule sizes and pore sizes.

BACK PRESSURE OR PRIORITY VALVE—A valve used to maintain a constant gas pressure in a purification unit or system. Prevents surges, turbulence, and high gas velocities through the system.

DEHYDRATION—The removal of water and water vapor from gases such as air, nitrogen, helium, argon, or hydrogen.

DESICCANT—A material used for drying and purifying by adsorption.

DEWPOINT—Temperature at which water vapor begins to form as a liquid (at atmospheric pressure unless otherwise indicated). Stated as —100 F D.P. etc.

FILTRATION RATING—Absolute, Nominal—The term *absolute* means absolutely no particles over the rated micron size specified will pass through the filter. *Nominal* means that approximately 98% of the particles of the micron rating specified will be stopped by the filter.

MICRON—A unit of measurement of solid particles size. One millionth of a meter or approximately 0.0004 inch. For practical reference, 25 microns equal one thousandth of an inch. Used for rating filters.

MOLECULAR SIEVE—A high grade desiccant suitable for temperatures up to 250 F and for critical or selective vapor removal to extremely low dewpoints or hydrocarbon levels.

OIL VAPOR—Oil reduced in density to a vapor. Should be specified in parts per million by weight (ppm/w). When specified as ppm/v (by volume) the name of a specific hydrocarbon must be stated as a reference value to correctly define the true amount.

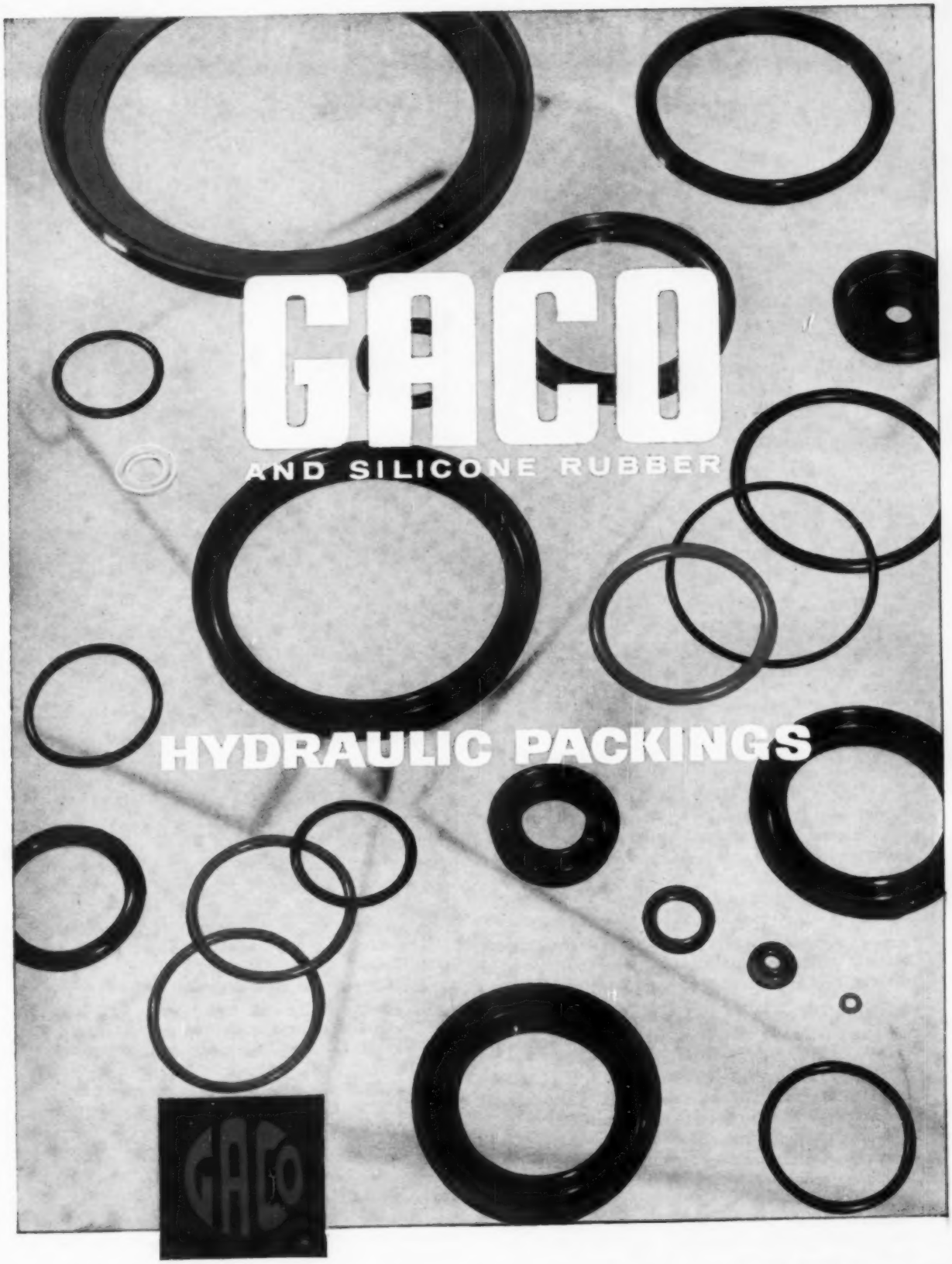
SCFM—A term for gas flow measurement (standard cubic feet per minute). Actual volume of gas flow in cubic feet per minute if the gas were at atmospheric pressure and 70 F.

SELECTIVE ADSORPTION—The removal of one or two chemical compounds from a gas mixture without disturbing the remaining compounds. Example: removal of CO_2 from ethylene vapor.

SILICA GEL—An inexpensive desiccant primarily used for the removal of water vapor at temperatures below 85 F and for dewpoints to —75 F.

VAPOR PRESSURE—A means of expressing the maximum water content of gases; based on the pressure exerted by a saturated vapor.

WATER VAPOR—Water reduced in density to a vapor. Should be specified in terms of dewpoint at atmospheric pressure, but may also be stated in ppm/v, ppm/w, relative humidity, absolute humidity, etc. and converted to D.P.



GEORGE ANGUS & Co LTD OIL SEAL DIVISION, COAST ROAD, WALLSEND-ON-TYNE
Telephone: Wallsend 624551 • Telex: 53138 • Telegrams: Gaco Wallsend, England

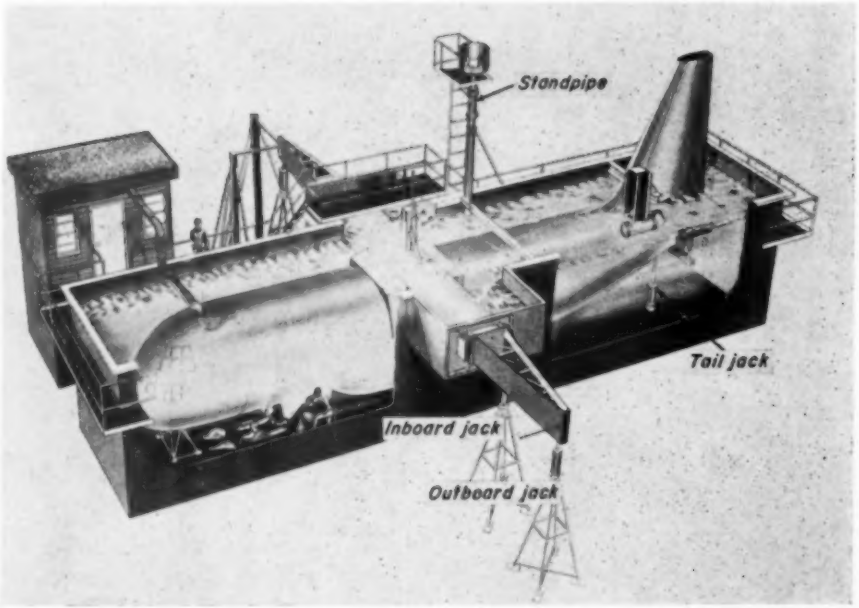
A63

Hydraulic tests simulate plane's flight loads

• By D. S. MORCOCK *and* W. M. LAW,

Lockheed Aircraft Corp., Marietta, Georgia

This hydraulic system for stress testing requires multiple pressure and flow controls to prevent overloads on the frame.



FUSELAGE SHELL with stub horizontal stabilizer, center wing section, and vertical fin, rests on dummy landing gears on reinforced concrete slab. A 270,000-gallon steel tank surrounds the fuselage.

FLYING in water? That's how Lockheed engineers simulated flying loads on a plane. They subjected a C-130 Hercules transport fuselage to anticipated flight loads to evaluate the fatigue effects of 20,000 simulated flights. In about 90 seconds they put loads on the plane comparable to an actual flight of 3 hours at an altitude of 20,000 feet, hauling a 40,000-lb cargo.

The test simulates cabin pressure by submerging the plane in a huge water tank. At the same time five hydraulic jacks apply simulated flight bending loads.

• **Cabin Pressure Test**—Into tank and open plane are pumped 270,000 gallons of water, submerging the plane and filling the tank to a predetermined level. Technicians then remotely close and lock the plane's doors with built-in hydraulic jacks, and pump water from the tank into the fuselage to pressurize the cabin. The loading jacks are actuated at the same time. Water pressurizes the plane simultaneously rising in a standpipe connected to the fuselage until the inside pressure is 7.5 psig. At this point, the water in the standpipe closes a float switch, opening the water dump valves, and energizing the solenoids that remove the loads from the five jacks. Bending loads and internal pressure loads gradually return to zero.

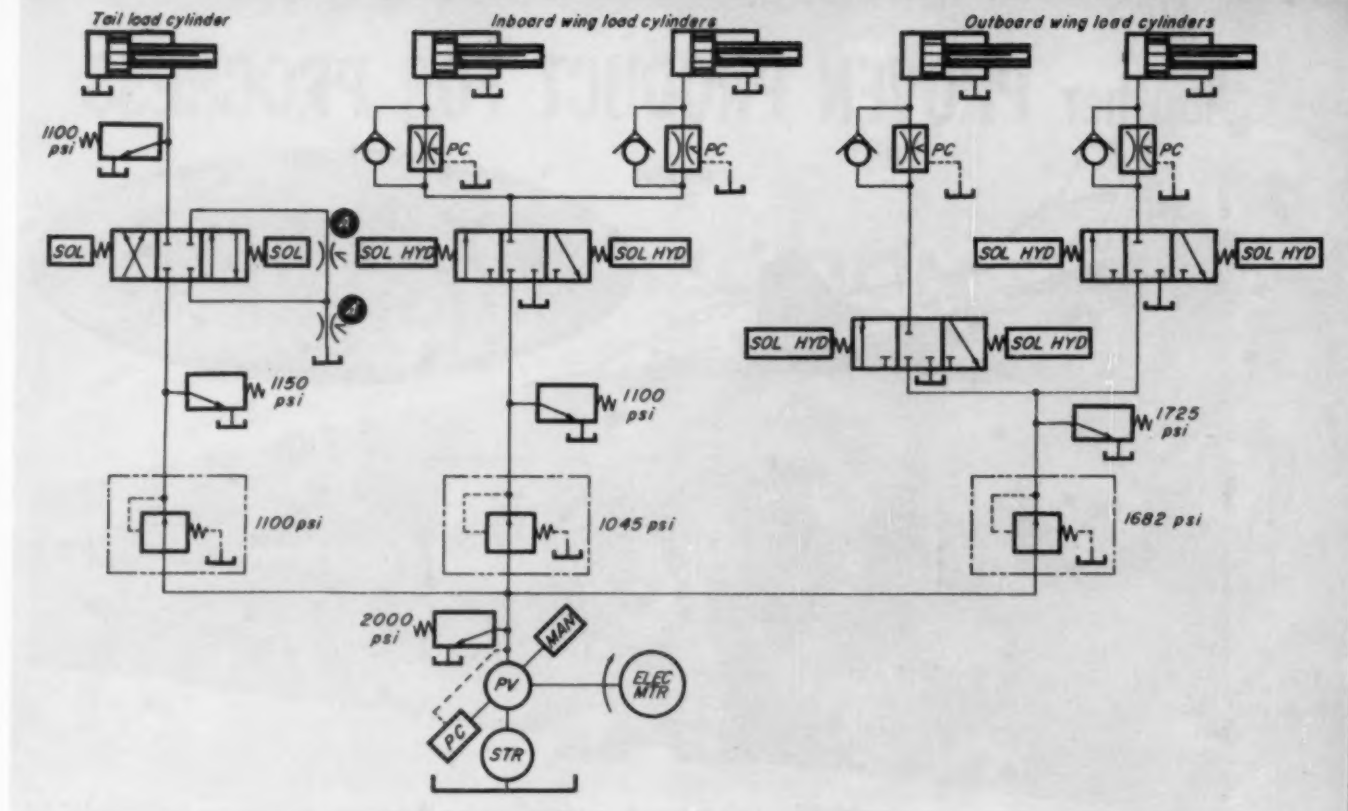
• **Hydraulic Circuit Design**—Two cylinders are connected to each wing jig, and one to the tail. The wing jacks raise the wings while the rear jack pulls down on the tail. The fuselage is limited in its upward motion by straps and cargo loaders moored to the concrete floor of the water tank. The bending and shear loads coupled with the internal hydrostatic pressure loads inside the cabin simulate the theoretical fatigue damage a plane would encounter in one complete flight.

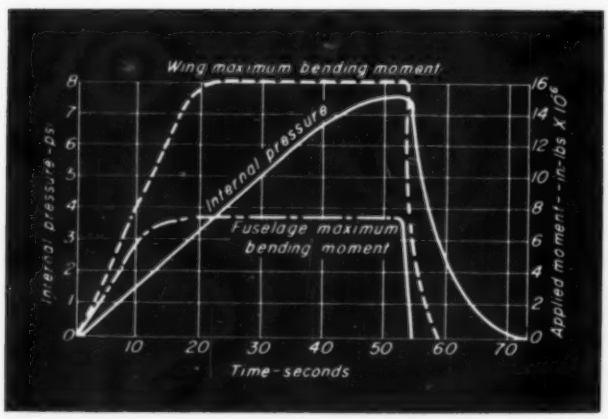
The test required these controls:

- Independent pressure control to the pair of outboard jacks, the pair of inboard jacks, and the tail jack.
- Independent flow control to each jack.
- Control over the settling rate of the airframe after depressurizing all jacks.

Pressure reducing valves, and pressure-compensated flow control valves gave independent flow and pressure controls. Arrangement of a needle valve and check valve in parallel with the flow control valves provided the right settling rates .

To avoid excessive loads, should the pressure reducing valves fail, Lockheed engineers installed a secondary relief valve in each circuit, downstream of the pressure reducing valves. The secondary relief valves were set to relieve slightly above the circuit load pressures and sized to handle maximum pump





PRESSURE REDUCING VALVES gave engineers independent pressure control for the inboard, outboard and tail jacks. Pressure compensated flow control valves provided independent control to each jack.

TYPICAL BENDING LOADS and internal pressure applied to fuselage during one test cycle.

flow without excessive pressure override.

Three-position, 3-way, closed-center valves controlled all jacks. The purpose of closed-center design: to hold the airframe in whatever position it assumed in case of malfunction or failure. This was important to enable engineers to examine and study the plane's structural damages. Though leakage created some creep with the valves in neutral, the closed circuit system proved valuable, the inconveniences negligible.

• **Wing Valving**—The wing jack valves were solenoid—controlled and pilot-operated. The valves had built-in restrictions in the pilot lines to eliminate pressure surges due to the large oil flow rates to the wing jacks. Only one valve controlled both inboard jacks. However, each outboard jack was controlled by a separate valve. This was a safety precaution to allow the electrical control system to stop flow to the wing that might be rising faster than its mate.

• **Tail Valving**—Control requirements for the tail valve were rather unusual. Unlike the wing control valves, this one was not pilot actuated. In this test it was necessary to maintain a constant restraining load on the tail downward, yet allow it to rise when the wing loads were applied upward, and the fuselage was forced up in the water. It was also necessary to prevent sudden take-up or resulting shock load, either when the wings were unloaded, or at the beginning of the next cycle.

This was done by letting the tail jack ease back to its unloaded position as the wing jacks were unloaded. For this purpose an additional relief valve set at 1100 psi, was installed in this circuit together with flow control valves *A*. Now, when solenoid 1 was energized to let the tail jack retract after the wings were unloaded, only enough oil was metered through valves, *A* to overcome cylinder friction, and ease the piston back to its unloaded position.

A 35-gpm variable displacement, axial piston pump with handwheel volume control and pressure compensation, powered the jacks in this 2000-psi system. Test cycling was automatic, and controlled electrically. As a precautionary measure duplicate electrical control panels were built to enable test engineers to switch controls in case of malfunction. ▼▼▼

Another PROVEN PRODUCT FOR PROGRESS

FROM

CLEMCO
AERO PRODUCTS, INC.

3-POSITION FLAP ACTUATOR

This actuator operates the trailing edge flaps on the McDonnell F4H Naval Aircraft.

The double piston feature provides three positions for the flap surfaces with internal locking retracted. The flaps are highly preloaded in retracted position, and the lock mechanisms, therefore, are continually operating under the dynamic lock load specified.

The lock segments actuate switches which provide a cockpit signal and system depressurization. Three different versions of this application have been successfully qualified to McDonnell detail specification and MIL-C-5503. The service experience is extensive dating back to 1958 on all F4H aircraft.

The world's leading producer of proven rotary tab and flutter dampers and specialists in the design and manufacture of

ACTUATORS: Rotary and Linear
Hydraulic and Pneumatic

POWER STEERING AND DAMPING UNITS

PROPRIETARY DESIGNS OF HYDRAULIC AND PNEUMATIC UNITS FOR COMMERCIAL AND MILITARY AIRCRAFT, MISSILES AND INDUSTRY

PRESSURE SWITCHES
PNEUMATIC AND HYDRAULIC RESTRICTORS
RESERVOIRS AND ACCUMULATORS
RACK AND GEAR ROTARY ACTUATORS

VALVES: including...
Solenoid Operated Shut-off
Hydraulic and Pneumatic, Check-High Performance
Pressure Regulating
Acceleration Actuated
Cryogenic

EXCLUSIVE MANUFACTURERS OF
Tee-Loc® and *Inter-Lok*
INTERNAL LOCKING HYDRAULIC ACTUATORS

THE NEW CLEMCO CATALOG

Now, hot off the press...270 pages of proven products for progress. Designs to meet your specific application of the products listed will be supplied immediately upon request.

Hathaway INSTRUMENTS INC

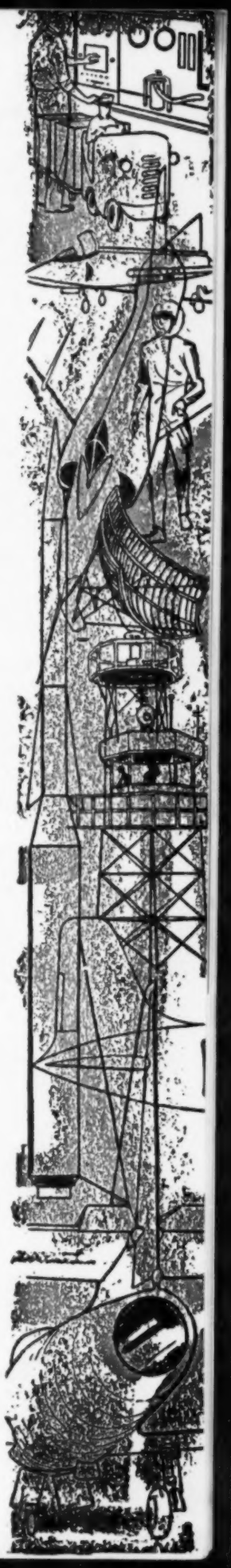
CLEMCO AERO PRODUCTS, INC.

15225 South Main Street, Gardena, California

A subsidiary of HATHAWAY INSTRUMENTS, INC.

AEROSPACE SECTION

Fluid Systems For Flight and Ground Support



Aerojet Enters Space Systems Field

Aerojet-General Corp. recently announced the formation of a major new subsidiary for the design, development, and production of complete missile and space systems. The new company is the Space-General Corp. combining the staffs of Aerojet's Spacecraft division and its subsidiary Space Electronics Corp. As part of a multi-million dollar investment in facilities and capital expenditures, a new, 200,000-sq ft plant will be built for Space-General on a 73-acre site already selected just east of Los Angeles.

Janitrol Completes Cryogenic Test Facility

A facility to test components and systems operating on liquid hydrogen, liquid nitrogen, and other cryogenic fluids was recently put into operation by the Janitrol Aircraft Division of Midland-Ross Corp., Columbus, Ohio. There are very few privately operated, cryogenic testing facilities capable of handling liquid hydrogen.

The facility includes a 500-gal double-walled, vacuum-jacketed, test Dewar tank, a 5000-gal supply Dewar tank, an associated vacuum-jacketed, fluid transfer system, and complete instrumentation for recording temperatures, pressures, flow rates, and vapor quality determinations. The test Dewar is 48 in. in diameter and 72 in. deep, and it accepts assembled components of that size. Sensitive instruments are available to record all test parameters on a common time basis. The cryogenic test equipment compliments the altitude chamber added to the testing facility in 1959.

Measuring Pressures to 1,000,000 psi

Industry uses pressures as high as 1,000,000 psi to synthesize materials such as diamond and boron nitride. Pressures as low as 1-trillionth psi are being measured in work on atomic accelerators. Special research programs for the National Bureau of Standards for both high and low pressures will provide standard measurement methods, a well-defined scale of pressures, and data on the properties of materials at various regions of the pressure scale.

Another area of the Bureau's investigation of the properties of materials is the development of methods for precisely measuring the physical and chemical properties of materials at very high temperatures. A new method of thermal conductivity measuremnt of metals, solids, and granular materials at high temperature has been developed.

EDITORIAL ADVISORY BOARD

Charles H. Cannon
Lockheed Aircraft Corp.

H. G. Conway
Short Bros. & Harland Ltd.

Howard D. Davis
Convair Astronautics

Kenneth W. Dubois
Douglas Aircraft Co.

Grady Gilder, Jr.
Chance Vought, Inc.

William E. Mayhew
Republic Aviation Corp.

Ralph E. Middleton
Lockheed Aircraft Corp.

E. T. Raymond
Boeing Airplane Co.

John W. Ruttle, Jr.
The Martin Co.

W. F. Talbot
Northrop Aircraft, Inc.

Frank Mladinich
Grumman Aircraft Engineering Corp.

HYDRAULICS HELPS THE HELICOPTER PILOT by relieving him of flight loads previously felt in the stick. Use of servomechanisms was the first step in that direction. More recently, automatic flight stabilization equipment was developed.

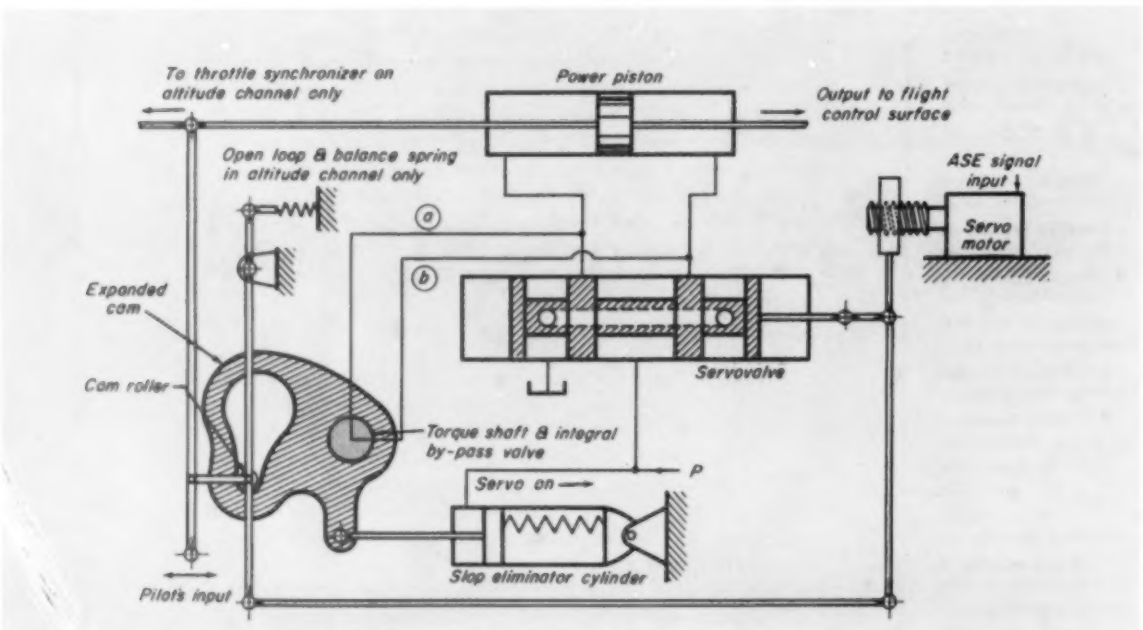
Hydraulics helps handle

• By **ALBERT J. TOLOMEO,**
Section Head Hydraulics & Controls, Aircraft Design & Development Branch,

and **EDMOND R. VIANNEY,**
Assistant Branch Chief, Systems Design & Development Branch, Sikorsky Aircraft Div., United Aircraft Corp., Stratford, Connecticut

HYDRAULIC powered, flight control systems were added to helicopters to assist the pilot and lessen fatigue. As helicopters grew in size and weight, it became necessary to replace completely pilot effort with hydraulic force. Hydraulic servos were added, so that now two and even three independent systems are employed on a helicopter. This added complexity required reliability and fail-safe operation in the components and systems.

Later another requirement was added—automatic flight stabilization in all four modes of operation, pitch, roll, altitude, and yaw. The automatic stabilization equipment introduces pitch, roll, altitude, and yaw signals from electronic sensors and combines them



COMBINATION OF AUTOMATIC STABILIZATION EQUIPMENT AND PILOT INPUT LINKAGE. The influence of ASE electronic input signals is limited and the additional slop available in the expanded cam always allows the pilot to override the ASE even when in hard-over position. The success of this system has enabled Sikorsky to couple in additional electronic navigational, sonar, and ground tether circuits.

helicopters

differentially with the pilot's manual inputs.

Besides flight control actuation, three other applications of hydraulics on the Sikorsky S-58 helicopter are described here. These are the rescue hoist, the main rotor brake, and the main wheel brake.

Hydraulic Flight Controls

The S-85 has both a primary and a secondary or auxiliary flight control hydraulic system, each with its own set of hydraulic servos coupled into the mechanical system. Each system is complete and independent. Both are identical and operate between 850 and 1000 psi. Normally, both the primary and auxiliary units operate simultaneously, with the auxiliary operating unloaded since the control loads are reacted fully by the primary servos. In case one system fails, changeover is automatic and instantaneous without any objectionable effect on the control sticks. Also, both sets of system servos are each designed to react the full control forces. Thus, the pilot does not experience any difficulty nor discomfort when operating on one set only.

Loss of hydraulic pressure in one system immediately reverts its servos to a manual position by automatically actuating an integral by-pass valve. This allows free motion of the power piston.

HELICOPTER CHARACTERISTICS INFLUENCE HYDRAULIC DESIGN

Here are a few characteristics of helicopters that greatly influence both the basic design and location of hydraulic components and circuitry. All Sikorsky helicopters use the fully articulated rotor blade. Changing the pitch of each blade the same amount moves the craft up or down. Cyclic pitch variations move it forward, backward, or sideways. A mixing unit coordinates pilot control motion from the stick with the rotor head. This unit, with its many bellcranks, is a source of control friction. Therefore, if a helicopter is big enough to require two hydraulic servo systems, one should be between the pilot's control stick and the mixing unit, as close to the pilot as possible. Similarly, since the source of control system loading is in the rotor head, the second servo should be as close to the head as possible. These two servos should be completely independent.

With a reciprocating engine, where a pad is available, one servo system pump is mounted on the engine and the other, on the main rotor transmission. This satisfies two additional helicopter requirements. First, with an in-flight engine failure, during autorotative descent, the servo system powered from the transmission will still operate, reacting flight loads. Second, following rotor head engagement, high cyclic forces could appear once per revolution because of blade bearing friction, blade out-of-track conditions, or too fast an engagement. The servo system powered by the engine will react these loads.

Since at least one servo system must be available for flight, pressure switches are used as interlocks between the systems. They insure that both systems cannot be turned off simultaneously, and that one system cannot be turned off unless the other system is at operating pressure. Also, these pressure switches automatically restore pressure to a system that has been electrically turned off, when loss of hydraulic pressure occurs in the operating system.

There is a 3-way, shut-off valve in each system. It allows the pilot to test the operation of each power control system separately. Also, if a component in a system should fail, he can shut down that entire system.

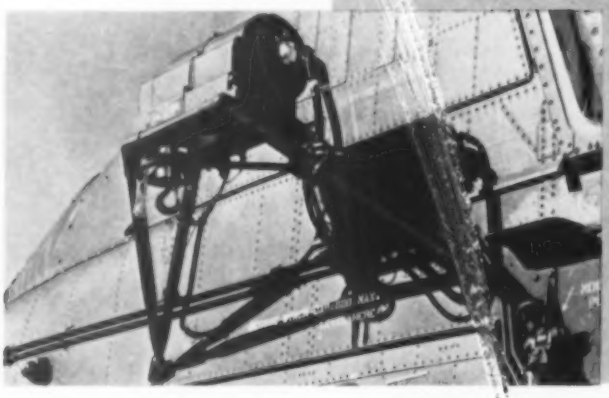
The primary system uses a piston-type, pressure-compensated, variable-delivery pump which cuts off at 1000 psi. It is driven by a power take-off from the main rotor transmission gear box. The auxiliary system also uses the same type of pump. It is mounted on the rear accessory section of the engine and driven by the accessory drive.

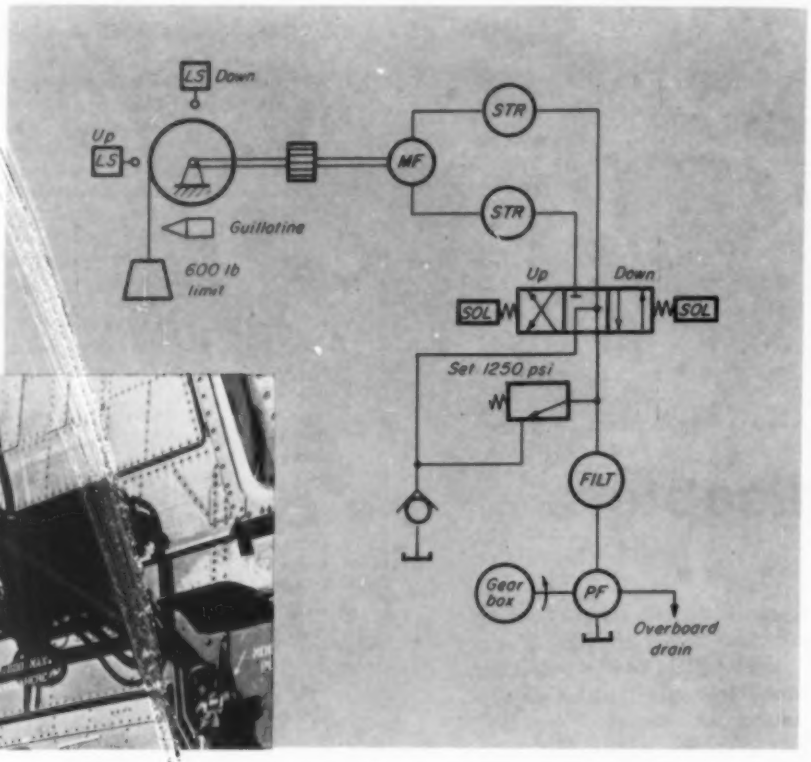
Automatic Flight Stabilization

Automatic stabilization equipment (ASE) improves the handling characteristics of the helicopter by introducing static and dynamic stability. The ASE is Sikorsky's method of transducing electrical signals into mechanical control displacements. The linkage allows ASE corrections to be introduced into the flight control system, so that the pilot has complete control of the helicopter at all times through normal use of flight controls.

Each channel of each ASE's servo unit has an expanded cam pinned to a common torque shaft. System pressure retracts the spring-loaded, slop eliminator cylinder and holds it in the *servo-on* position. The slop cylinder rotates the expanded cam and torque shaft. The rotation moves the cam roller out of its locked position at the lower end of the cam. Roller travel inside the cam represents both ASE authority and pilot override authority, that is, both the ASE and the pilot can move the servovalve piston, with the pilot having override control. Upon loss of servo system pressure, the slop cylinder extends and rotates the torque shaft, eliminating roller travel inside the cam. This prevents lost motion in the control

HYDRAULICS HELPS HANDLE HELICOPTER





HYDRAULIC RESCUE HOIST is mounted over the fuselage door. Regardless of the prime mission of a particular model helicopter, the Services feel it should be capable of performing the rescue function. So most aircraft are equipped with a hoist.

system. The integral by-pass valve in the torque shaft prevents hydraulic lock of the power piston when there is no servo system pressure. The by-pass valve allows free power piston movement when only manual control is necessary. An additional double-acting spring is in the follow-up linkage on the altitude channel only, to provide for pitch stick balance and to provide an open loop device to extend ASE authority for this channel.

Rescue Hoist System

Rescue work by helicopters is one of their most widely known and dramatic missions. Sikorsky's first use of hydraulics on its helicopters was for the rescue hoist. It has a cable drum, a gear driven by the hydraulic motor, a load-holding mechanical brake that is hydraulically released, a level wind mechanism for the cable, and a rubber covered bumper at the cable end fitting. A rubber covered roller prevents cable snarling when unreeling without a load. Limit switches cut off hydraulic power at both extremes of cable travel. An electrically-operated, cartridge-type guillotine, installed integral with the level wind mechanism, can cut the cable in an emergency.

The mechanical brake is integral with the cable drum and acts in one direction only. It holds the load when there is no system pressure. The brake is hydraulically released, so that the load can be lowered, when pressure to the motor rotates a cam plate which disengages the clutch and releases the load. When raising a load, the clutch free wheels so that the load is raised directly.

Power take-off for the pump is from the main rotor transmission gear box. Normal lifting capacity of the winch is 600 lb at about 100 ft/min. The relief valve is set to crack at 1250 psi, which is the system's design limit pressure. The pilot controls the winch with an electrical switch on his azimuth stick. Also, he may shift control to the cabin.

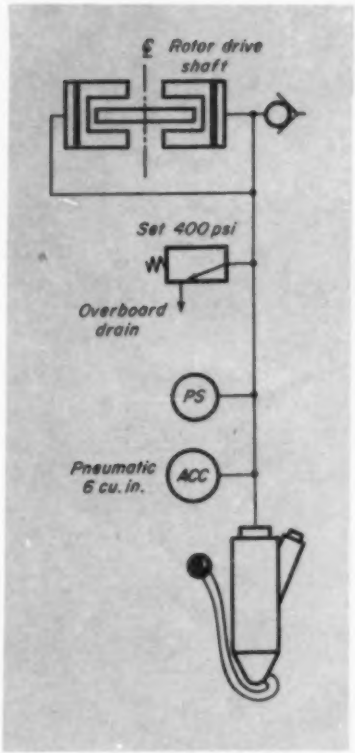
Main Rotor Brake System

A non-pressurized, hydraulic brake system stops the main rotor and prevents it from windmilling. The brake is capable of stopping the main rotor from autorotative motion in 15 sec. (Maximum rotor speed occurs during autorotation and is about 10% to 15% higher than normal, power-on rotor speed. Autorotation enables a helicopter to descend safely without engine power.) The master brake cylinder is mounted on the ceiling of the cockpit. The brake handle attached to the brake cylinder moves down and forward, discharging hydraulic fluid, pressurizing the brake system, and actuating the two brake halves of the brake unit. An over-center linkage and a spring-loaded, manually operated pin hold the brake handle in the extreme forward or parked position.

A 6-cu. in. accumulator precharged to 250 psi of air at room temperature furnishes thermal compensation for the brake system in parked position. Normal, parked system pressure is about 10 psi higher than accumulator precharge pressure. While parked, system pressure may vary from 210 psi to 280 psi during a 40-degree F temperature change.

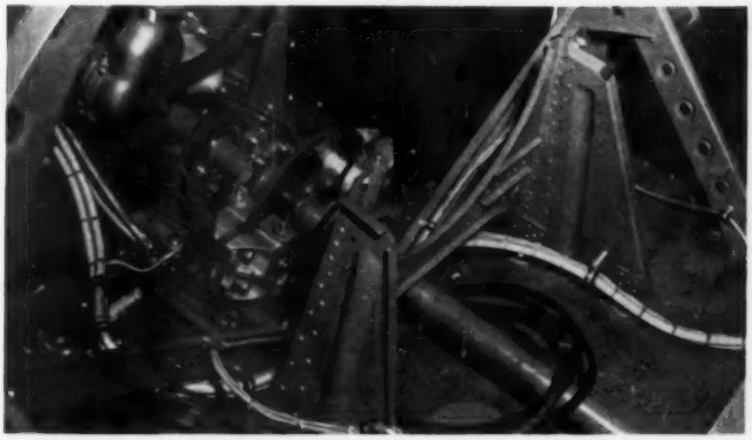
Main Wheel Brake System

The pilot applies the left or

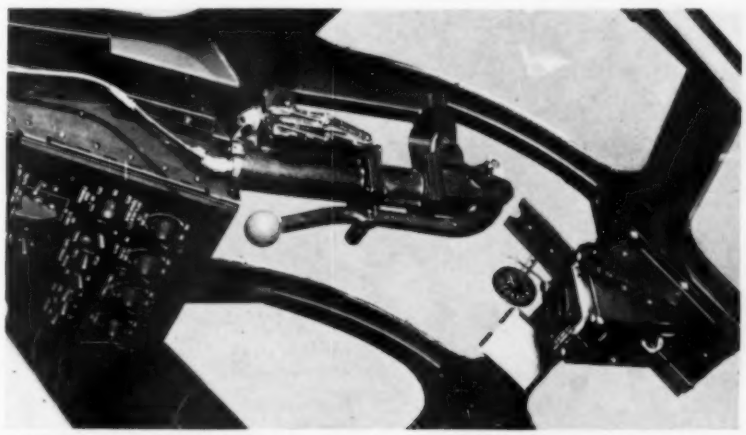


MAIN ROTOR BRAKE SYSTEM has a pressure relief valve discharging overboard. It prevents overpressurization of the system in case of improper servicing of the accumulator or bleeding of the system. A pressure warning light, pressure switch, and interlock relay prevent rotor head engagement with the rotor brake applied. The check valve is a bleed point. The system is filled at the master brake cylinder.

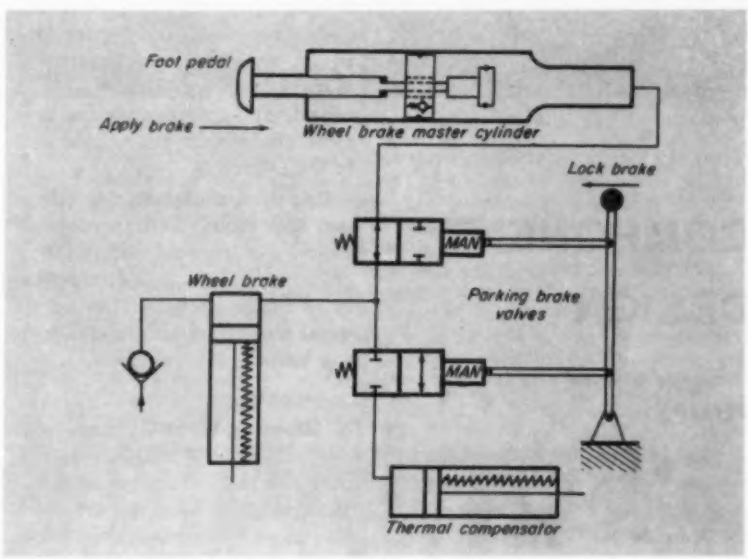
right main landing wheel brakes by depressing the corresponding foot pedal. This actuates the dual piston of the master brake cylinder. At first, displacement of the large piston area is effective for a short portion of the stroke to fill the wheel brake cylinder rapidly. Displacement of the small piston is then effective for the rest of the stroke to develop the required braking pressures with reasonable pilot effort. As the small piston takes over, there is a smooth transition because excess fluid from the large piston is channeled through a relief valve. Depressing the foot pedal and pulling out the parking brake lever closes the dual parking brake valves and locks the wheel brake. The two parking brake valves are arranged for temperature compensation. ▼▼▼



TWO SELF-ADJUSTING BRAKES, actuated by the main rotor brake system, engage a brake disc mounted on the tail rotor drive shaft. Actuating this system stops both the main and tail rotors at the same time.



MASTER BRAKE CYLINDER pressurizes the main rotor brake system when the pilot operates the brake handle. The handle is shown in flight (brake-off) position.



LEFT AND RIGHT MAIN WHEEL BRAKE CIRCUITS are similar and independent. Each is actuated by a foot pedal. The undercut near the large piston seals when the pedal is depressed.

How to reduce contamination from components

• By H. D. DAVIS, *Group Engineer, Hydraulics Design Group, General Dynamics/Astronautics, A Division of General Dynamics Corp., San Diego, Calif.*

Contamination control begins with component design and continues through selection of materials, manufacturing processes, cleaning, testing, and packaging. This article covers components other than servovalves which were discussed in the May '61 issue of HYDRAULICS & PNEUMATICS.

COMPONENT DESIGN

PUMPS

Because they are complex and operate at high speeds, hydraulic pumps can be a major source of contamination.

The case, or housing, is the primary source of built-in contamination. Usually it is an anodized aluminum or magnesium casting with many cored and drilled passages. Extreme care must be used in cleaning the housing before assembly to remove contaminants from these blind passages.

Also some surface treatments, particularly those using magnesium, may be very friable and may not adhere well to the base metal. To prevent them from contaminating the system, the inner surfaces of the housing may be sprayed with a resin coating after normal surface treatment. This coating is considerably more adhesive and more pliable than the normal surface treatment.

Improved manufacturing operation also reduce built-in contamination. For example, shrink fitting of mating parts in preference to press fitting prevents shaving off metal particles which would later contaminate the pump.

• **Bearing Wear**—Pumps wear primarily in the bearings and at the valve plate or the piston shoes. If antifriction bearings are used, they must be carefully selected to prevent contamination. One manufacturer has found that bearings with bronze spacers are less susceptible to spacer wear than those with steel spacers. In pumps using hydrodynamic thrust bearings, the bearing design must provide adequate lubrication and minimize the load per unit area.

A valve plate in rubbing contact with the rotating cylinder barrel generates fine, flake-like particles of the softer material, about 5 microns in diameter. Careful hydraulic balancing between these parts prevents excessive wear, and is also necessary in pumps which have piston shoes moving relative to a wobble plate. It is similar to cylinder barrel wear. This design is balanced by bleeding oil through the piston and shoe from the cylinder. Then high pressure oil tends to lift the shoe from the wobble plate during the piston's pumping stroke.

After a break-in period, using an adequate break-in fluid, a pump should be disassembled, inspected for excessive wear, recleaned and reassembled. Disassembly removes wear products which are not flushed out by simply operating the pump.

Hydraulic motors are similar to hydraulic pumps, so expect them to have the same contamination characteristics.

Continued on page 130

Circle 174 →

Watch Weston for new concepts...

This miniature, electro hot-gas servo valve developed by Weston for the U.S. Army's "Mauler" Missile weighs only .18 pound.

Now Weston
GAS SERVOS
and **SYSTEMS**
offer new standards
of performance!

From this tiny gas actuated servo, to complete hot or cold gas-servo systems, Weston's pioneering of this advanced control concept has produced a practical design—proved reliable—and offering new standards of performance. ■ Eliminating the conventional "soft" response usually associated with gas actuators, this new design provides the fast forward response and positive reverse stiffness of a hydraulic system—yet operates way beyond the environmental limits of hydraulics. It can be stored indefinitely, has fewer components for greater inherent reliability, and up to 50% less weight than a hydraulic system. ■ A general bulletin is available on this new Weston design, and a specific proposal or a test demonstration can be arranged on request.

Development and test firing of Weston Gas Servo Systems are conducted in this special laboratory.

weston
HYDRAULICS LIMITED
A SUBSIDIARY OF BORG-WARNER CORPORATION

WESTON HYDRAULICS B-W BORG WARNER

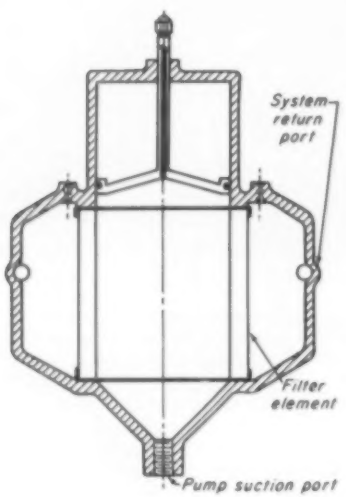
7500 Tyrone Ave., Van Nuys, Calif. • Telephone TRiangle 3-4340

Mauler is being developed by Convair/Pomona, Convair Division of General Dynamics, for the Army Rocket and Guided Missile Agency, an element of the Army Ordnance Missile Command.

RESERVOIRS

Gas-pressurized, piston-type reservoirs and some boot-strap reservoirs are exposed to the same hazards as piston accumulators. The solutions suggested below for accumulators also apply to reservoirs. However, the reservoir holds a large volume of oil and has low fluid velocities. The reservoir should not be placed at a dead end. Instead, fluid should flush the reservoir so that contaminants are trapped by the system filters. The suction port should be placed where particles will enter the suction line rather than being allowed to settle in some inaccessible point. Return ports should be arranged to agitate the fluid, while still permitting deaeration. A port arrangement which creates a centrifugal effect accomplishes this purpose. However, the pump suction port should be placed away from a vortex or adequately baffled to prevent air from entering the port.

Reservoirs with a low pressure filter are ideally suited to this suggested design. The filter acts as the baffle for the pump suction port, and return ports may be placed so flow is tangential into the cylindrical reservoir.



HYDRAULIC RESERVOIR designed for contamination control. Sloping bottom guides particles to suction port, so that they can be trapped by the system filter. Return ports are tangential to reservoir sides. This causes contaminants to remain in suspension and deaerates incoming fluid by centrifugal effect. Reservoir may be converted to a free surface or boot-strap reservoir by modifying the upper housing.

ACTUATORS

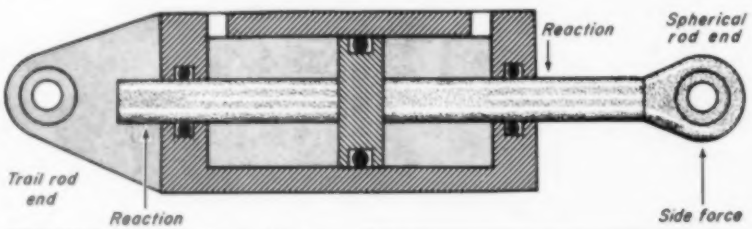
A flight control actuator usually is attached directly to the servovalve so compressible bulk of load oil is reduced. Thus, particular attention must then be given to the actuator to prevent it from contaminating the second stage of the servovalve.

The primary source of contaminants in common linear actuators or vane type rotary actuators is material built-in during manufacture. This can be avoided by proper fabrication methods and care in cleaning and assembly. In addition, careful choices of materials and processes must be made.

Products of wear are the second source of contaminants, assuming that only clean fluid is used in the actuator. To reduce wear, linear actuators should act as two-force members, to avoid side loading and resultant bearing loads. The actuator piston should be of trail-rod design to reduce bearing of the piston against the cylinder walls.

Wear particles of dynamic O-rings often cause considerable background clutter on oil-sample, filter disks. In most cases this is only an annoyance and can be eliminated by using Teflon cap strips or piston rings. Tests by Boeing showed that granulated O-ring material does not seriously hamper servovalve operation.

Rotary actuators should be the simplest practical vane type. Avoid designs which have large bearing areas exposed to the fluid, as in some actuators which transform linear motion to rotary.



TRAIL ROD CYLINDER has two bearings. With bearings at both ends of the cylinder, bearing design is more adequate than when side load reactions are supported by the piston rod and a single bearing. Here the piston is designed for axial load only. Its fit is just tight enough for sealing, yet loose enough so the piston does not support any side load. The spherical rod end causes the cylinder to be a 2-force member.

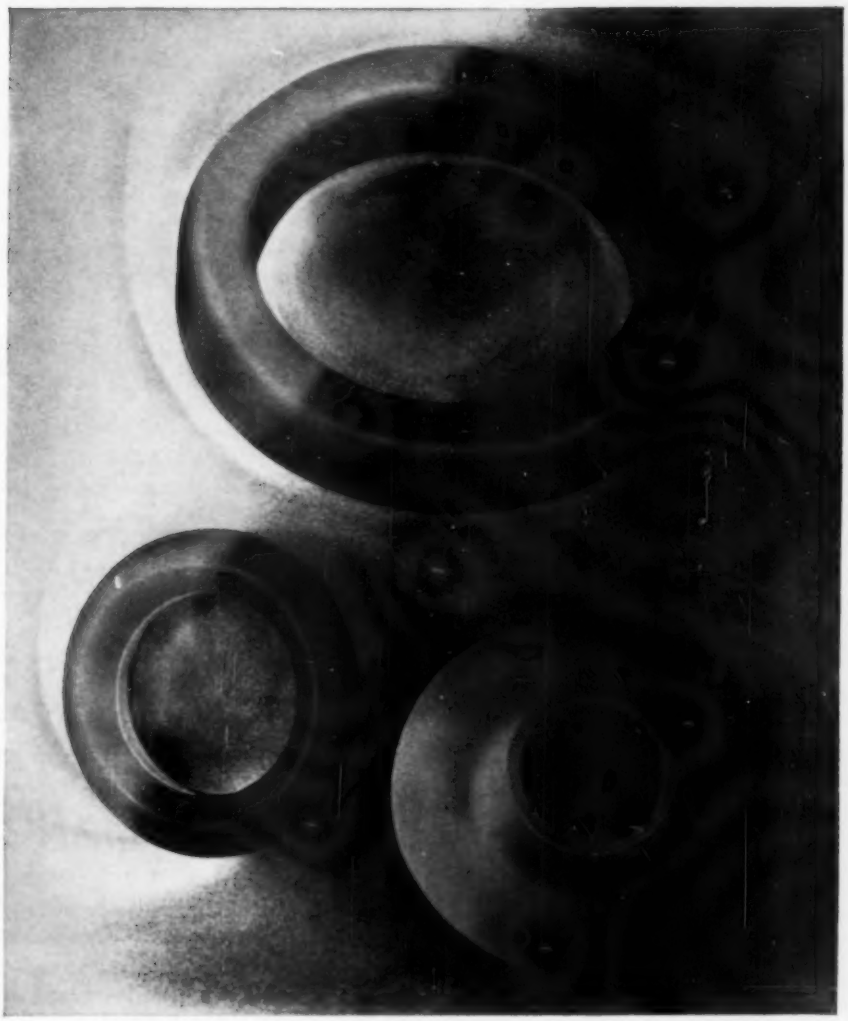
ACCUMULATORS

At Astronautics, piston-type accumulators are often more contaminant sensitive than servovalves. Since the accumulator is usually on a dead-end line, it is not flushed during system operation. Also, it is difficult to produce sufficient pressure pulsations in the system to exercise the accumulator. So contaminants settle there and are difficult to remove.

Accumulators fail because these contaminants, trapped in the O-ring groove, cause accelerated wear of the O-ring or embed in the ring allowing the gas charge to leak into the oil. The problem is worse in systems where a separator type reservoir prevents deaeration of the fluid. Gas leakage

Continued on page 132

MOLY-S_2*, the newest of a variety of impregnations, is available in all shapes of Garlock leather packings . . . molded cups, "U" and "V" packings, washers, gaskets, discs, hat packings.



REMARKABLE NEW MOLY-S_2 IMPREGNATE

. . . adds exceptional anti-friction properties to Garlock leather packings. This new packing lubricant—molybdenum disulfide, a solid material—greatly reduces frictional drag at high pressures (above 1500 p.s.i.), and minimizes wear during break-in periods at low pressures. Heretofore highly effective as a metal lubricant, MOLY-S_2 is now successfully impregnated deeply and evenly throughout the fibers of Garlock leather packings, where it cannot be washed away by operating fluids or forced out under severe pressures. MOLY-S_2 has no melting point, will not separate or break down, is insoluble in water, and contains no graphite or fillers.

Because of its unusual adhering qualities, new MOLY-S_2 impregnate is excellent where fluid or gaseous mediums provide little lubrication to moving parts, or where high pressures limit the amount of vital surface lubricating film. For ideas on how you can apply Garlock leather packings with MOLY-S_2 impregnation, talk to your local Garlock representative. He's at the nearest of the 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for catalog AD-186. Garlock Inc., Palmyra, N. Y.

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company.

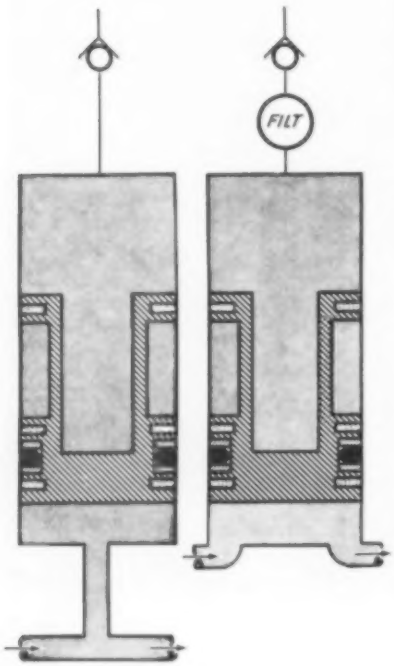
Order from a complete line of quality Garlock products . . . Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*Garlock Trademark for molybdenum disulfide

GARLOCK

into the oil may cause low pressure system failure.

To reduce the amount of contaminants, the accumulator should be scrupulously cleaned before installation in the system. It should be placed *across* a line rather than on a dead-end line. The O-ring seal should be placed between Teflon piston rings. This permits the piston rings to scrape contaminants from the cylinder walls, giving added protection to the sealing O-ring. A filter should be installed in the air charging system of the accumulator.



ACCUMULATOR SHOULD BE CONNECTED IN SERIES instead of parallel for good contamination control. This flushes contaminants from the accumulator and exercises the piston. The O-ring seal has two back-up rings, and they are placed between Teflon piston rings (shaded) which scrape contaminants from the accumulator wall. Teflon bearing ring is optional at the air end of the piston.

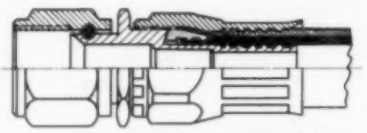
HOSE

Synthetic rubber hoses present two difficulties. They may become partially soluble in some hydraulic fluids. This releases gummy substance into the hydraulic fluid. Secondly, hoses formed over mandrels lubricated with carbon black embed this material in the walls of the inner tube. In subsequent use in the system when the hose is flexed and pressure cycled, graphite is freed from the rubber and released into the system.

If abrasive cut-off saws are used to cut the hose to length, both rubber and Teflon hose should be thoroughly flushed *before* applying pressure during manufacturing pressure tests. The expanded pores of the hose can trap metal and abrasive particles when pressure tests are conducted on hose which is not adequately flushed after cut-off.

Teflon-lined hoses are most adaptable to hydraulic system cleanliness. Even here, attention should be paid to manufacturing methods to avoid contamination during fabrication. As with rubber hose, solid lubricants should be avoided if forming tools are used to fabricate the inner tube.

Hose end fittings should be designed so that the sealing lands which engage the hose will not scrape off particles of the inner tube as they enter the tube. Non-scraping is achieved by using a buttress or a screw thread land design, or by arranging the lands to grip the outside of the inner tube.



Courtesy Resistoflex Corp.

SWAGED HOSE END FITTING has lands that grip the inner tube and braided wire. Particles are not scraped from the inner tube, so the system is not contaminated.

DESIGN & MANUFACTURING

METAL FORMING

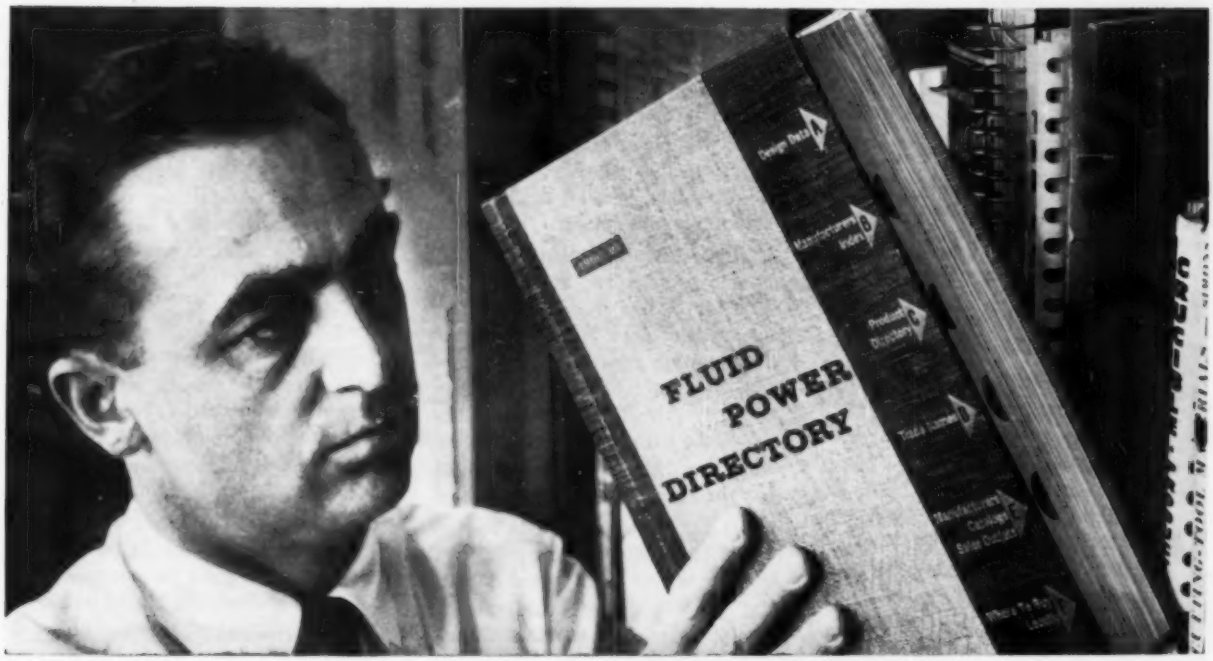
To avoid inclusions inherent in castings it is preferable to use forged or wrought raw stock. Even die castings and lost wax castings tend to have mold materials, carbonaceous, or metallic material adhere to the casting. This is difficult to remove during cleaning.

If a casting is the only practical solution to the design of the component, all surfaces exposed to the fluid should be machined to remove the cast surface. Cored passages and particularly cast-in parts should be avoided if possible. Although drilled passages present cleaning difficulties, largely at intersections of passages, they are generally smoother than cored passages, and there are no shake-out or burn-in difficulties from core material.

• **Particles Imbed In Surface**—For such metal forming processes as drawing, bending, and particularly bending and flaring of tubing, the tools, lubricants, and work piece must be kept clean. During forming, metallic and hard non-metallic particles adhering to the tools and work or included in the lubricant can be ironed into the work piece. Where the contaminant is similar to the base metal, it may be lightly pressure welded to the part. Non-metallic and dissimilar metallic particles may be imbedded in the surface of the part. Since a large amount of energy is applied to the particle to create adhesion during forming, a large amount must also be applied to detach it. Because this amount of energy is not usually available in normal cleaning processes, it is important to have the

Continued on page 134

Fourth Edition (1962/63) Now In Preparation



Fluid power problem? Solve it with the

FLUID POWER HANDBOOK & DIRECTORY

Since 1956, the standard reference and source book of fluid power. Over 1000 pages, 140 product groups

DESIGN DATA AND IDEAS—Over 300 pages of standards, nomographs, formulae, circuits and product designs. Complete JIC hydraulic and pneumatic standards.

INDEX TO MANUFACTURERS—Names and addresses of more than 600 companies making products for fluid powered machines.

PRODUCTS DIRECTORY—Locate manufacturers of hydraulic, pneumatic and electrical products.

TRADE NAMES—Tells you who makes a product when you know only its trade name.

SPECIFICATIONS—Catalog information on manufacturers' products. Index pages give information on sales offices and distributors for each advertiser.

LOCAL SOURCES—(Yellow Pages) All local sources for fluid power components are listed by state, city and company.

COMPILED AND PUBLISHED BY Hydraulics & Pneumatics THE MAGAZINE OF FLUID POWER

Reserve Your Copy Now
For Delivery
November 1961

FLUID POWER HANDBOOK & DIRECTORY
812 HURON ROAD, CLEVELAND 15, OHIO

Please reserve ( ) copy(ies) of the 1962/63 edition @ $12.00 a copy. ($15.00 outside the United States).

☐ **Check enclosed** ☐ **Bill me**

Name: ..... **Title:** .....

Company: .....

Address: .....

City: ..... **Zone:** ..... **State:** .....

UNDERSTANDING CONTAMINATION

tools, lubricants, and work piece clean during forming.

It is advisable to de-burr, degrease, and dry each part before each forming operation. Ultrasonic cleaning and vapor degreasing are advisable.

METAL JOINING AND HEAT TREATING

Welding, brazing, or silver soldering should be done *before* final machining, or else a clean-up machine operation should be used *after* the metal-joining operation. All rough surfaces resulting from these operations, which are exposed to the fluid, should be machined smooth to remove oxide or flux inclusions. After machining, the joint should be inspected carefully to insure that the surface is free of pockets.

Welding of sleeves or bushings to the body of the component should be avoided since it is usually very difficult to remove oxides from the inside of the bushing after welding. For the same reason it is preferable to use screw-in or expandable plugs instead of welded plugs.

From the contamination control standpoint, heat treatment is ideally performed *before* machining the internal surfaces of the part. This is suggested because oxides formed during heat treatment are difficult to remove from these surfaces. Aluminum alloys are most adaptable to surface machining after heat treatment. But where high strength, alloy steels and ordinary steels are used, this suggestion is almost impossible to follow, unless all surfaces are finish ground.

SURFACE TREATMENT AND FINISHES

In selecting surface treatments for internal parts, pay careful attention to friability and adhesiveness of the platings. Cadmium, zinc, and tin platings, for example, should be avoided because they flake or scrape off easily. Electroless nickel, if properly applied, chromium, and anodizing are satisfactory substitutes for these materials. However, hard, brittle chromium plating should be supported on a firm base which prevents fatigue of the plating material. Springs subject to high torsional stress should be left unplated to avoid flaking.

Some surface treatments used on magnesium are extremely friable and flaky. They should not be used, or they should be glued down with a resin coating. A surface coating that flakes is a particularly irritating problem because the process is never-ending. Flakes are deposited in the fluid for the life of the component.

To have a short wear-in period for metal-to-metal wear surfaces and to reduce O-ring wear, sliding surfaces should be as smooth as possible consistant with economic considerations. Metal-to-metal wear surfaces should be held to 8 microinches. O-ring or other dynamic sealing surfaces should range from 8 to 16 microinches.

ASSEMBLY & PACKAGING

After the individual parts making up the component are manufactured, they are delivered to the clean room, where they are ultrasonically cleaned, inspected, and assembled into the component. The component is now ready for final test. Fittings, adaptors, tube assemblies, and fixtures previously exposed to the test fluid must be cleaned and packaged. These parts may be used in only one test setup, then they must be re-cleaned and re-packaged.

After setting up the test-circuit, a dummy component should be substituted for the test article, and fluid circulated through the system for ten to fifteen minutes to flush out any thread burrs, clothing lint, or air-borne contaminants that may be in the circuit.

After testing, the component is ready for preservation, closure, and packaging. Before final closure, it should be filled with filtered, preservative oil. This protects the internal parts from corrosion.

For closing the component, it is suggested that male plugs should not be used. Male plugs might deposit thread burrs in the female ports, resulting in component contamination. The ideal closing method is to install the fitting and gasket which will be used in the flight vehicle. Then removal of the fitting will not be required and a male end is available for capping, with less likelihood of contamination. Male ports, of course, may simply be capped without additional fittings. Military standard, anodized aluminum tube caps are recommended. Polyethylene and cork-gasketed, soft aluminum shipping caps should be avoided.

The final operation in the clean room is packaging the component in a transparent, hot sealed, vapor barrier, plastic wrapper. Tubing and flexible lines need only have their ends sealed. Then the component may be taken from the clean room and packaged for shipment.

In this article, primary emphasis has been placed on the presence and effects of contamination in the individual component. It may appear that unnecessary pains have been taken to insure cleanliness in components which may not be contaminant sensitive. However, through years of experience the author has found that once contamination is built-in or generated in a system, it cannot be removed. It will certainly find its way into critical components—filtration and flushing notwithstanding. If contamination is to be controlled, it must be attacked at the lowest level and pursued to the highest. ▼▼▼

COMING NEXT MONTH

- Award papers in HYDRAULICS & PNEUMATICS' Prize Paper Contest
- Program and Abstracts of National Conference on Industrial Hydraulics

Circle **37** on Reader Service Card

Model ES4-KM2 ½ actual size

ONE-WAY IMPULSE SWITCH

simplifies sequencing circuits

- ★ Eliminates Interlocking Switches and Complicated Actuating Dogs
- ★ Exclusive one-way actuator sends electrical pulse when depressed, then opens circuit. No pulse on actuator return.
- ★ Gives More Dependable Operation — replaces complicated controls
- ★ Lowers Cost of Control Circuits—fewer switches required
- ★ Faster Automatic Operation — closer sequencing possible

10 amps, 125v AC

Four models available with pulsing strokes from 1/16" to 3/8".

Described in Data Sheet ESC-7

$10.50 plus 25c shipping. Write for Quantity Discounts

CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION
4224 W. Lake St., Chicago 24, Ill. • VAn Buren 6-3100 • TWX CG-1400

Manufacturers of a full line of switches, controls and indicators for all military and commercial applications. All standard units stocked for immediate delivery by leading parts Distributors.

measurement and control

OF PRESSURE AND DIFFERENTIAL PRESSURE

DELTADYNE® SWITCHES
Pat. No. 2,942,572
Adjustable for signalling pressure and differential pressure from 0.25" wc to 200 psi (or psid) in systems to 5000 psi and −65° to +275°F; leak-proof. Units sound alarm, light bulb, turn motor on or off, operate valves—remotely or in place. **$40 to $75**

DELTADYNE INDICATORS
Adjustable and non-adjustable. Actuation 0.01 to 100 psi (or psid). For same pressure/temperature as switches. Red button pops to give visual indication of overpressure. **$22 to $85**

DELTADYNE GAUGES

For system pressures to 3000 psi; indication from 0 to 60 psi differential; leak-proof—no moving seals; high-visibility scale. **$92**

Extended pressure and temperature ranges available in all instruments.

NEW DESIGNS!

NEW ACCURACY!

OFF-THE-SHELF OR CUSTOM-ENGINEERED FOR

- Hydraulic/pneumatic systems (airborne, ground support, industrial)
- Process industries (chemical, petroleum, fuels)
- Equipment manufacturers (fluid handling)

Read or control tank levels, and pressure drops across filters, heat exchange orifices for flow metering, gas adsorbers and many other types of equipment. Learn more about the cost and service advantages of these units.

WRITE FOR COMPLETE LITERATURE

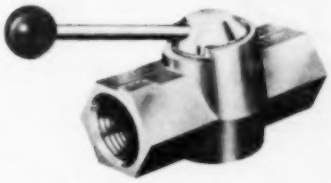
PALL

PALL CORPORATION • GLEN COVE, N. Y.

Circle **125** on Reader Service Card

CIRCLE SEAL PLUG VALVE

...LEAKPROOF IN HIGH VACUUM SERVICE



9200 SERIES

Positive sealing in high vacuums to 150 psi. Sizes ⅛", ¼", ⅜", ½", ¾". Available in brass or 303 stainless.

CIRCLE SEAL precision valves

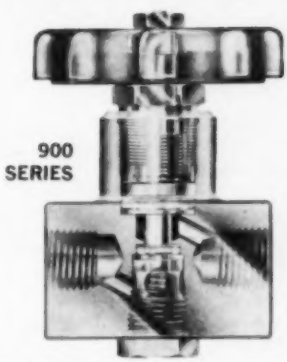
Design of the Circle Seal 9200 Series Plug Valve features use of three O-rings. In closed position, O-ring on cylindrical face of plug prevents leakage past inlet port. In open position, the valve is fully ported and allows straight-thru flow passage. Stem leakage is entirely eliminated by static O-rings at top and bottom around circumference of plug. Effortless quarter turn from full open to full close. No springs used...no adjustments required.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

CIRCLE SEAL HIGH PRESSURE SHUTOFF VALVE

...LEAKPROOF Fingertip Operation



900 SERIES

0-6000 psi. ¼" pipe and ⅜" tube connections. 303 Stainless construction.

CIRCLE SEAL precision valves

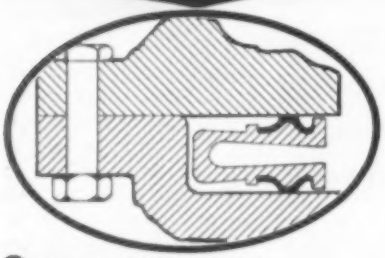
Unique design combines **positive** leakproof shutoff with full flow passages and freedom from wire drawing. Design of stem and seat permits simplified throttling of flow. Light fingertip operation actuates either a handwheel or toggle lever for rapid actuation. Unique and useful variations on the basic 900 Series configuration: • Right angle flow. • Integral Relief—combines relief valve function with shutoff permitting cylinder thermal pressure relief, etc. • Triport with one inlet and two outlets or one outlet and two inlets.

CIRCLE SEAL precision valves

Military Service:
JAMES, POND & CLARK, INC.
Industrial Service:
CIRCLE SEAL PRODUCTS CO., INC.
2181 East Foothill Blvd., Pasadena, Calif.

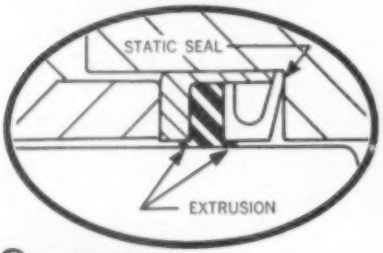
Circle **33** on Reader Service Card

FOR UNIQUE OR CRITICAL SEAL PROBLEMS



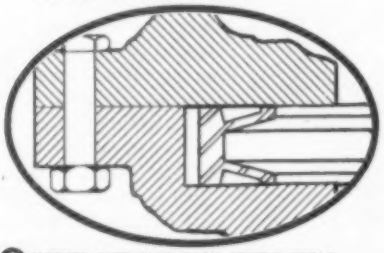
1 DEL PNEUFLEX STATIC SEALS

- Designed specifically to meet cryogenic applications of low and high pressure requirements in missiles and high performance aircraft.
- A flexible metallic ring with protruding Teflon sealing edges. Uses inherent spring property of the metal ring and the pressure being sealed to force a tight joint.
- Temperature range from —450°F to 500°F at pressures up to 5000 PSI. Re-usable. Requires only light flange loading.



2 DEL SHAFT SEALS

- For reciprocating or low speed rotary motion.
- Only spring-loaded Teflon seal using extrusion principle.
- Guarantees leak-proof fit, controls cold flow . . . is self-compensating for wear.
- Temperature range of —320°F to 500°F at pressures up to 10,000 PSI.



3 HASKEL METALLIC FACE STATIC SEALS

- Silverplated Inconel-X seals.
- Designed specifically for extreme temperature requirements of systems in missiles and high performance aircraft.
- Integral height control. Install by indexing seal to one mating surface and bringing opposite surface against seal.
- Temperature range from —450°F to 2000°F at pressures up to 20,000 PSI. Re-usable. Requires only light flange loading.

For complete information, contact

HASKEL SEALS A DIVISION OF

Haskel ENGINEERING & SUPPLY CO.

1236 So. Central Avenue, Glendale 4, California

Circle **78** on Reader Service Card

AEROSPACE COMPONENT DATA

High Temperature Valve

Features: An elongated stuffing box removes the packing from the hot zone in the valve body of this stainless steel tubing valve. A two-piece stem, which does not rotate against the seat, prevents galling or scoring of seat and stem.

Specifications: For gas or liquid service at temperatures to 1000 F and pressures to 30,000 psi. Even higher fluid temperatures can be used if the valve body is well insulated and if the packing area is well ventilated.

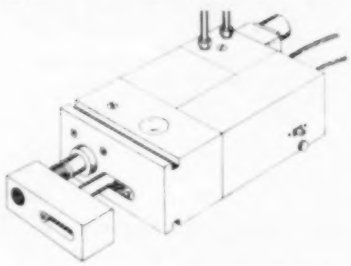
Designation: AE Hi-Temp Valve. —*Autoclave Engineers, Inc., Erie, Pa.*

Circle **500** on Reader Service Card

Servo Actuator

Features: Integrated servo actuator with oversize load bearings contains a servo amplifier, servovalve, and hydraulic cylinder. Can be applied to special machinery requiring high performance positioning such as specimen testing and structural loading of missiles. Solid state amplifier. Solid block, plug-in construction. Integral mounting of the feedback coupling permits positioning accuracy better than 1 part in 1000.

Specifications: Stroke lengths from 1" to 6". Cylinder diameters from 1-¼" to 2-½". Output thrust, 5 tons. Speeds to 40"/sec. Frequency response to 40 cps (90° lag). Con-



trol, either local or remote. Built-in power supply.

Designation: Model 410—*American Measurement & Control, Inc., subsidiary of CompuDyne Corp., Hatboro,Pa.*

Circle **501** on Reader Service Card

Explosion Proof Solenoid Valve

Features: Poppet design, 2-way solenoid valve can be changed from normally open to normally closed by interchanging parts within the valve. This explosion proof valve

has balanced parts, low pressure drop, and no leakage. Controls fluids or gases, including helium, at pressures to 3000 psi. Has lost motion solenoid for positive operation.

Specifications: Uses 60 cycle, 110 vac. Temperature range is —65 F to 160 F.—*Vinson Mfg. Co., Van Nuys, Calif.*

Circle **502** on Reader Service Card

Continued on page 138

Circle **158** on Reader Service Card

TRIGGER QUICK

FINGER-TIP OR LANYARD RELEASE

FAST
EASY
POSITIVE

New Symetrics 500 Series Disconnects (3000 psi) offer these famous Symetrics features: Lightest weight . . . smallest envelope . . . zero leakage during disconnect . . . no air inclusion during connect . . . Full pressure and no exposed seals after disconnect . . . Unique design exceeds MIL-C-25427.

Other models available in plastic and special materials. For information on other Symflow Disconnects, write to:

SYMETRICS COUPLINGS

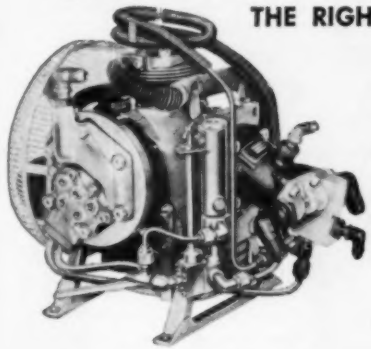
SYMETRICS, INC.

2919 NEBRASKA AVE., SANTA MONICA, CALIF.

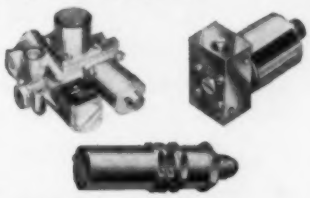
Circle **107** on Reader Service Card

MC *high quality costs less*

THE RIGHT START PAYS IN THE END



MC customers have learned that our thoroughness in all steps—designing, scheduling, planning, manufacturing, controlling, testing—means real economy in aircraft and missiles. We invite your inquiries and your visits—our well established and well equipped facility is efficient and flexible—ready to serve you!



We can solve your fluid system problems, supply subsystems and many types of valves; also pumps, dehydrators, etc.

WRITE, WIRE, or PHONE for data, quotations, and service.

M. C. MANUFACTURING COMPANY

LAKE ORION, MICHIGAN • PHONE: MYrtle 2-2711

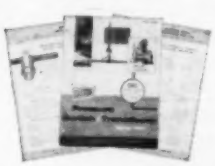
Need qualified Pressure Switches for Aircraft & Missiles?

1500—1600 Adjustable, 0.5—4000 psig, -2—200 psia

1580 gage—1880 absolute, Miniature (4 oz.), 2—3000 psi

HAYDON SWITCH will help solve your requirements with its proven line of miniature and subminiature, gage, absolute and barometric adjustable and non-adjustable Pressure Switches . . . qualified to MIL-E-5272. SPDT or DPDT circuitry with sealed or unsealed snap-action switches, and high-temperature versions available.

Write for your FREE Pressure Switch Bulletins today . . .



1702 Altitude sensing, 500—50,000 feet

1590 gage, Subminiature (2½ oz.), 10—3000 psig

HAYDON Switch INCORPORATED

WATERBURY 20, CONNECTICUT

PLaza 6-7441

Circle **79** on Reader Service Card

INSTANT PRESSURE REGULATION

0 TO 3000 PSI

Proven Superior in Comparative Tests

WITH THE *Futurecraft* **HI/LO HAND LOADER**

GENERAL SPECIFICATIONS	
Port Size	¼" tube per AND 10056
Pressures	Operating—0-3000 psi Proof—6000 psi Burst—7500 psi minimum
Flow	Exceeds any other loader available
Operating Temperatures	0 to + 160°F
Weight	2½ pounds

Futurecraft

DISTRIBUTION CORPORATION

1717 N. Chico Ave. So. El Monte, Calif.

Representatives in principal cities

WRITE TODAY for complete details

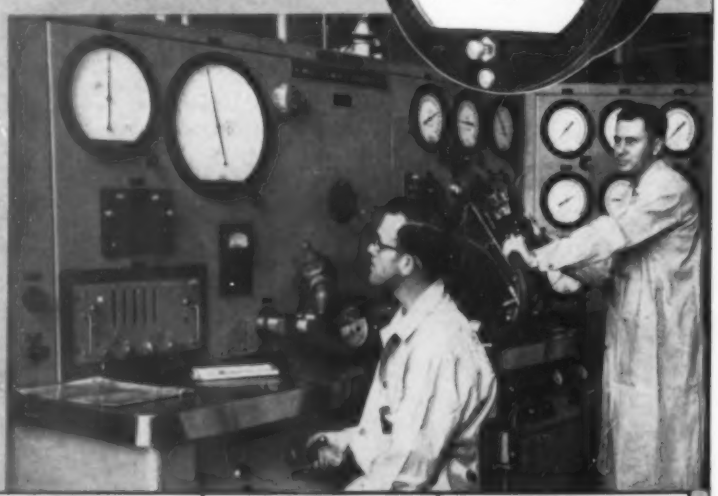
Circle **60** on Reader Service Card

HEISE GAUGES

Where ACCURACY *is Paramount*

Aircraft and missile programs, vital to national defense, are dependent upon reliable laboratory data in the design of power plants and their components.

Only instruments of the highest caliber are selected for use on research projects in this critical field and, where hydraulic pressures are involved, Heise Gauges are invariably specified.



ACCURACY	HYSTERESIS	CAPACITY
0.1 of 1%	0.1 of 1%	0-100,000 p.s.i.

This Hydraulic Test Stand, manufactured by the Test Equipment Division of Consolidated Diesel Corporation and featuring Heise Gauges, is typical of the aircraft and missile ground support equipment that goes into the defense effort.

Dial Sizes	FULL SCALE READING (P.S.I.)						
	0-15 to 0-5,000 inclusive	Over 0-5,000 and including 0-20,000	Over 0-20,000 and including 0-30,000	0 to 40,000	0 to 50,000	0 to 75,000	0 to 100,000
8½"	$183.50	$205.50	$238.50				
12"	$209.50	$231.50	$264.50	$275.50	$286.50	$336.50	$386.50
16"	$255.50	$277.50	$310.50	$321.50	$332.50	$382.50	$432.50

DELIVERY — 2 WEEKS FOR MOST RANGES — PRICE F.O.B. NEWTOWN

Request Catalog for SPECIAL FEATURES

HEISE BOURDON TUBE COMPANY, INC.

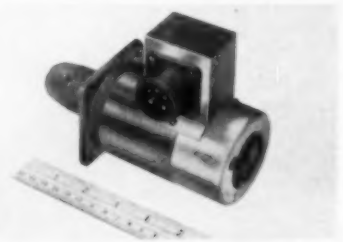
BROOK ROAD, NEWTOWN, CONNECTICUT, U.S.A.

Circle **80** on Reader Service Card

AEROSPACE COMPONENT DATA

Lightweight Hydraulic Pump-Motor

Features: Integral design of hydraulic power package saves weight by using a common shaft and bearing arrangement. It reaches overall efficiencies as high as 64%. The package was designed for the Pershing missile guidance system.



Specifications: Weight, 4 lbs. Size, 4" high x 4" wide x 7" long. Fixed displacement pump is driven by a d-c motor operating at 12,000 rpm. Rated delivery is 0.34 gpm minimum at 3250 psig over a voltage range of 25.5 to 30 vdc. Uses MIL-H-5606A fluid. Ambient pressure is sea level to 125,000 ft. Ambient temperature range for flight is −40 F to 300 F.—*Hydro-Aire Co., Burbank, Calif.*

Circle **503** on Reader Service Card

Pneumatic Bleed Valve

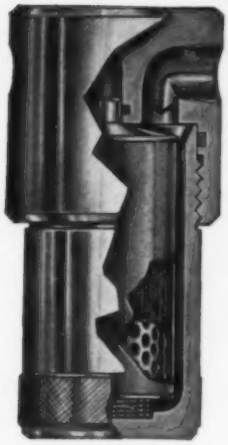
Features: This pneumatic bleed valve withstands pressures to 14,000 psi and has an operating pressure of 6000 psi at temperatures from −65 F to 160 F. It releases

with 20 lb of finger force at 6000 psi. This new design is mechanically simplified to reduce costs and increase reliability.—*Benbow Mfg. Corp., Culver City, Calif.*

Circle **504** on Reader Service Card

▼▼▼

Circle **57** on Reader Service Card



Looking for a standard microfilter rated up to (or above) 10,000 psi?

LOOK INTO THIS FD DESIGN**

Note (1) flow contoured inlet; (2) eccentric location of outlet; (3) deflection surface that guides stream around element. Result? At 10,000 psi inlet pressure, ½-inch filter passes 1000 SCFM (nitrogen at 70°F) without pushing ΔP above 50 psi. Dynaloy* C sintered stainless steel element removes 98% of all 10-micron particles (finer or coarser elements also supplied). Unit handles fluids from −320°F to +400°F. Available in ¼-inch to 1-inch sizes. Minimum burst pressure 36,000 psi. For detail sheet, for brochure (D-5), please write.

*Trade name of FLUID DYNAMICS Incorporated **Pat. Applied for

FLUID DYNAMICS
INCORPORATED
Dept. HP-9, 90 West St., New York 6, N.Y.

Circle **61** on Reader Service Card

Available from Stock!
NEW, INEXPENSIVE, LIGHTWEIGHT ORDNANCE CRYOGENIC COUPLINGS from FUTURECRAFT

Patent Number 2971782

Now you can replace obsolete cryogenic couplings with these new screw type units from Futurecraft—and connect flex lines, tubing or pipe quickly, easily and *safely fluid-tight.*

These couplings—service proven on Ordnance projects—are pressure rated at 150 psi operating, 300 psi proof and 450 psi minimum burst. Only low torque is required for a safe, tight seal. These Futurecraft couplings are available from stock in sizes from 1" to 4" in ½" increments, LOX cleaned and packaged. Installation tools are available.

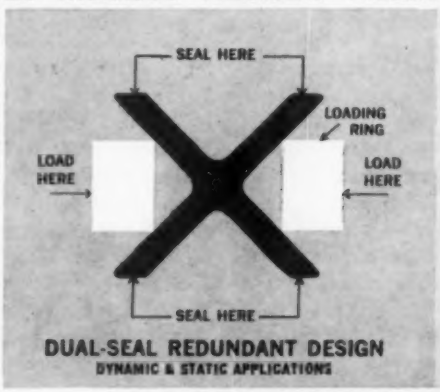
Write for complete details

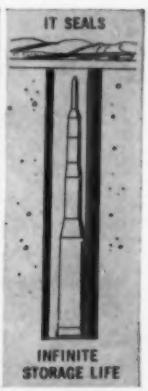
FUTURECRAFT DISTRIBUTION CORPORATION
1717 NORTH CHICO AVENUE • SO. EL MONTE, CALIFORNIA
Representatives in principal cities
TWX: ELM CAL 9678U • TELEPHONE: CUmberland 3-2113

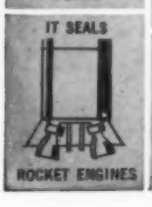
BAR-X SEALS EVERYTHING

AT TEMPERATURES FROM −400° F TO +1500° F!

ANY FLUID—GAS—FUELS—WATER—LIQUID METALS—CRYOGENIC FLUIDS—CORROSIVE FLUIDS
ANY SYSTEM—HYDRAULIC—PNEUMATIC—VACUUM—CRYOGENIC—NUCLEAR







NO CATASTROPHIC FAILURES
INFINITE STORAGE LIFE
UNPRECEDENTED SERVICE LIFE

Eliminates critical downtime ■ Very high and very low pressure ■ Easy, foolproof installation (not a mechanism) ■ All-metal—non-contaminating ■ Stable, symmetrical design

WRITE TODAY FOR THE FULL STORY! **SALES ENGINEERS IN PRINCIPAL CITIES.**

Wiggins

E. B. WIGGINS OIL TOOL CO., INC., Dept. D1
3424 E. Olympic Blvd., Los Angeles 23, Calif.
TWX 1403U, Phone AN 9-0181

Circle **175** on Reader Service Card

AEROSPACE NEWS

from the fluid power field

Hydraulics—Whipping Boy for Jet Crashes?

• By **SCHOLER BANGS**, *Western Editor*

What are the chances of hydraulic trouble aboard a jetliner?

What happens when it develops?

After the DC-8 runway crash at Denver in July HYDRAULICS & PNEUMATICS conducted a quick survey of jetliner operations throughout the United States.

Questions were put to U.S. manufacturers of jet-engined passenger transports: Convair, Boeing, Douglas, Lockheed. The Federal Aviation Agency was questioned. Data came in from airline operational reports.

None of the responses indicated hydraulic troubles caused fatal crashes or major accidents.

Hydraulic systems have produced far less trouble than other mechanical systems in jet-powered, commercial transports. Most jetliner hydraulic malfunctions are caught, and corrected, before the airplane ever leaves the ground.

One manufacturer of a jet transport has kept a detailed score sheet throughout 1960 on all mechanical malfunctions on more than 150 of its airplanes .

Of 50.6 mechanical delays per 1000 trip departures in 1960, 1.3 were attributable to hydraulic malfunctions. Among 32 sources of mechanical trouble, engines produced 6 delays per 1000 departures; pneumatic starters 4.1 delays; navigating instruments 4.2 delays; landing gear, including tire problems, 3.8 delays.

The manufacturer of another jet transport says that 7% of flight delays reported by airlines using its equipment were laid to hydraulic problems. Hydraulic fluid loss has resulted in aircraft turnback on a frequency of .09 per 1000 flight hours. Fluid loss causing trip departure delays showed a frequency of .25 per 1000 flight hours.

A third manufacturer reports hydraulic malfunctions to have been responsible for less than 7% of mechanical delays and trip cancellations in airline use of its jetliner.

Seven airlines using a fourth manufacturer's jetliner have reported a total of 71 hydraulic malfunctions during a period of one year and six months in which their planes were airborne for approximately 400,000 hours. No breakdown was given to show malfunctions in flight and those which were caught on the ground. If all were airborne malfunctions, the box score for this jetliner would be one hydraulic malfunction or failure per 6154 flight hours. Using a conservative flight speed for this aircraft, the hydraulic malfunction frequency would be approximately one per 3-million miles flown. Based upon the reported experience of other manufacturers, malfunctions aboard this jetliner probably accounted for only a small percentage of trip delays charged against all mechanical causes.

The foregoing should ease fears, raised by newspaper crash stories, that hydraulic failures present a safety hazard to airline cash customers.

At the same time, HYDRAULICS & PNEUMATICS' survey is not intended to alibi jetliner hydraulic malfunctions.

• **Causes of Hydraulic Failure**—Even though they may involve few, if any, passenger safety risks, they become costly to airlines in terms of revenues lost by delayed or canceled flights and costs of corrective overhaul.

With this in mind, HYDRAULIC & PNEUMATICS sought data on causes of jetliner hydraulic malfunctions.

Have failures been random, or do they show a pattern of frequency?

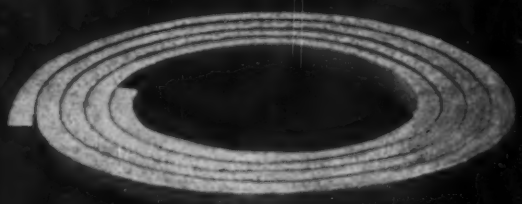
Should component manufacturers concentrate on improvement of particular components?

What parts might be strengthened or redesigned to reduce breakage; reduce failures due to installation errors; improve the overall passenger safety of jetliners?

Here are notes gathered from U.S. jetliner manufacturers:

Manufacturer A—"Of delays and/or cancellations attributable to the hydraulic power system (less than 7% of all mechanical delays and cancellations reported by airlines using our equipment) 63% were due to lines, hoses, and fittings. Of removals and/or

Continued on page 142

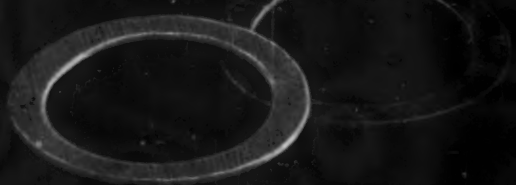


J-M CHEMPAC #2009 PACKING

This all-purpose packing provides low-friction sealing, effectively resists heat and chemicals. Asbestos yarns are braided solid, cannot ravel or come apart.

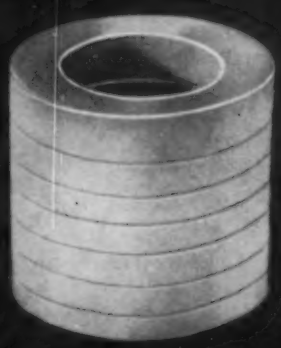
J-M CHEMPAC TEFLON ENVELOPE STYLE GASKETS

These gaskets have proved highly satisfactory in glass-lined equipment. The filler is protected against active chemicals and solvents by an envelope of pure Teflon.



J-M CHEMPAC SPIROTALLIC® FLANGE GASKETS

These highly resilient gaskets maintain a tight seal, and compensate for varying stresses and temperature changes.



J-M CHEMPAC V-RINGS

The unique design of these molded packings assures superior performance... low friction ... operational and dimensional stability.

Where service conditions are severe...

...JOHNS-MANVILLE CHEMPAC® PACKINGS AND GASKETS SEAL BETTER, LAST LONGER, RESIST CHEMICALS AND SOLVENTS

Chempac is the Johns-Manville trade name for a broad range of J-M materials which combine the excellent sealing and heat-resistant qualities of asbestos...with the immunity of Teflon* to almost all chemical and solvent action.

Because these J-M packings and gaskets provide such long, efficient and economical service, they are preferred by many producers of chemicals, petrochemicals, petroleum products, and foods. They also serve in critical missile and aircraft applications, in automobiles and in many electrical and electronic units.

If you need outstanding performance under virtually any severe service conditions, rely on J-M Chempac products. Your J-M Representative will be glad to help you select the correct style for your equipment and service requirements. Or, write to Johns-Manville, Box 359, New York 16, N.Y. In Canada: Port Credit, Ont.

JOHNS-MANVILLE

JM PRODUCTS

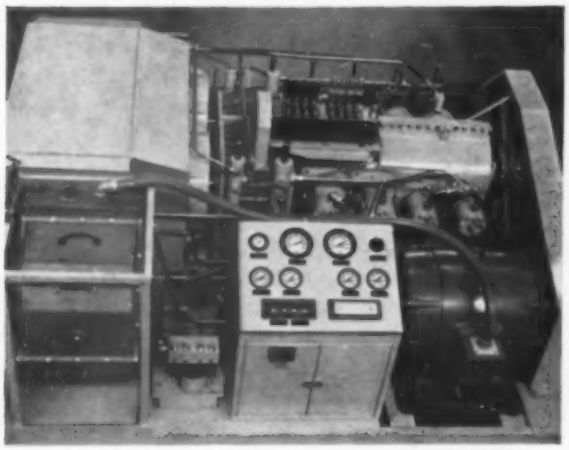
*DU PONT TRADEMARK FOR ITS TETRAFLUOROETHYLENE RESIN.

When You Need

HIGH PRESSURE
HIGH CAPACITY, HIGH PURITY

AIR, HELIUM NITROGEN

FOR COMPONENTS TESTING OR PRODUCTION



MODEL DPB-CCS Four-stage, 8-cylinder compressor. System includes full dehydration and oil removal, filter and complete control panel. Backed by Cardair's 20 years of high pressure gas experience. The only ICBM type compressor qualified by 2500 hour life test.

CCC CARDAIR
CENTRAL COMPRESSION SYSTEMS

Guarantee Delivery

- up to 12,000 psi continuous
- with less than 1 ppm oil content
- 150 SCFM @ 128 psig intake • dewpoint −100°F.

Developed and qualified as GSE equipment for ICBM program—now available from stock or programmed production!

Most recent broad purpose Central Compression System in the Cardair line, the Model DPB-CCS is a semi-portable, skid mounted unit, ready to install on location in less than a day. Only electrical and high and low pressure connections are needed.

In addition to air, helium and nitrogen, it can be easily adapted to other gases including hydrocarbons and hydrogen. Pressure range is from 3500 to 12,000 psi in continuous service and to 15,000 psi intermittently. Complete dehydration and oil removal equipment are included.

For either testing or production, it may also be used as a central high pressure source for diverse locations, with Cardair supplying the complete system.

Maintenance is simple and minimal, with nationwide Cardair service facilities. Installation is easy—no heavy concrete base is required.

Write today for illustration sheet and technical data—or send us information on your particular high pressure supply needs.

CARDAIR
DIVISION OF MARMON-HERRINGTON COMPANY, INC.
Dept. 16, Box 147—Lebanon, Indiana

Circle **28** on Reader Service Card

AEROSPACE NEWS

from the fluid power field

maintenance actions required in this system, 38% were due to lines, hoses, and fittings.

"The removal and/or maintenance actions rate has been:

"a) Due to lines, hoses, and fittings: 3.00/1000 flying hours.

"b) Remainder of hydraulic power system: 4.87/1000 flying hours.

"c) Total rate for hydraulic power system: 7.87/1000 flying hours."

Manufacturer B—"In our airplane, hydraulic pumps have been worst offenders. They have been responsible for 75% of basic pressure system trouble responsible for departure delays. In 1960 we recorded 2.4 pump failures per 1000 flight hours; 2.6 through the first half of 1961. This is equal to one pump failure per 440 flight hours of our airline users, or one failure every 2¼ days of operation.

"Of all mechanical malfunctions, producing 50.6 delays per 1000 departures in 1960, when the airplane still was relatively new in airline operation, hydraulic power failures accounted for only 1.3 delays per 1000 departures."

Manufacturer C—"In 350,000 flight hours, 97% of all hydraulic malfunctions reported by our airline customers were laid to (1) seals and bearings in utility pumps; (2) motors and gearboxes in utility pumps; (3) cracked "B" nuts, interference abrasion and improper installation in lines and fittings.

"Hydraulic problems accounted for 7% of mechanical flight delays.

"Hydraulic fluid loss has resulted in aircraft turnback on a frequency of .09 per 1000 flight hours, and a frequency of .25 per 1000 flight hours for trip delays caused by fluid loss.

"Of 15 auxiliary pumps which failed in flight, eight failures were caused by circuit breaker trips."

For the jetliner of *Manufacturer D*, not reporting directly, Federal Aviation Agency lists 71 hydraulic malfunctions during 18 months of use by seven airlines. This is the airplane reported by FAA as having logged approximately 400,000 flying hours during the period. By category, the malfunctions were:

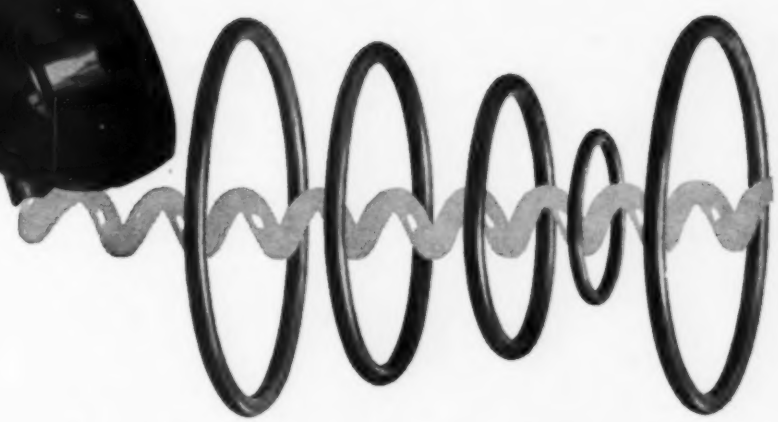
Pumps	4	Fittings	13
Valves	1	Accumulators	0
Actuators	8	Indicators	0
Regulators	0	Transmitters	1
Tanks	0	Switches	0
Lines	19	Seals	25

Here were the sources of seal troubles: O-ring failures—2; O-ring leaks—2; Back-up and O-ring pinched—1; O-ring decayed—1; Defective O-ring—1; Swollen O-ring—1; Leaking rudder boost thermal relief valve seal—1; Right power manifold ruptured

Continued on page 144

Call your National Applications Engineer for

engineering help
fast delivery
uniform quality
special compounds
on O-Rings



National's District Field Offices give you fast service on O-Ring engineering problems and O-Ring procurement. You talk with seasoned field engineers equipped with the latest O-Ring information and backed up by the plants of one of America's largest sealing products manufacturers. National O-Rings are precision-made, uniform in quality, specified and used by leading equipment manufacturers across America.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio; Redwood City and Downey, California

CALL YOUR NATIONAL FIELD ENGINEER

Atlanta 8, Georgia: George W. Smith Company, 394 Williams St., N.W., JAckson 3-7140; **Chicago (Franklin Park) Illinois:** 10013 West Grand Ave., GLadstone 5-4420; **Cleveland 18, Ohio:** 210 Heights Rockefeller Bldg., 3091 Mayfield Road at Lee, YEllowstone 2-2720; **Dallas 19, Texas:** Benson Engineering Company, 2514 West Mockingbird Lane, FLeetwood 2-7541; **Detroit 27, Michigan:** 13836 Puritan Avenue, VErmont 6-1909; **Indianapolis 5, Indiana:** 2802 N. Delaware St., WAlnut 3-1535; **Kansas City (Prairie Village) Kansas:** Benson Engineering Co., 2902 West 72nd Terrace, ENdicott 2-2843; **Los Angeles (Downey) California:** 11634 Patton Road, TOpaz 2-8163; **Milwaukee 4, Wisconsin:** 647 W. Virginia Street, BRoadway 1-3234; **Red Bank, New Jersey:** 16 Spring Street, SHadyside 7-3242; **Wichita, Kansas:** Benson Engineering Company, 519 So. Broadway, AMhurst 2-6971

6342

Glassco

BOURDON HELIX ENDS LINKAGE IN PRESSURE INSTRUMENTATION

In developing this single element Bourdon-Helix, Glassco engineers have eliminated linkage and other mechanical amplification in high-reliability pressure instrumentation. Even under the most severe military and space environments where shock, vibration and pressure surges destroy other instruments, Glassco pressure gauges and switches remain permanently accurate, never requiring recalibration or field service under normal operating conditions. Originally custom designed for special applications, today Glassco pressure instruments are available for all types of systems where lifelong accuracy is required. Send for our complete catalog of reliable pressure gauges, switches and transducers.

Glassco instrument company
777 South Arroyo Parkway,
Pasadena, Calif. SYcamore 5-3278

Circle 66 on Reader Service Card

AEROSPACE NEWS
from the fluid power field

seal–1; #2 engine hydraulic pump seal leak–1; #2 hydraulic pump shaft sail failure–2; #3 pump drive seal leak–1; Teflon seal failure, landing gear downlock bungee–1; Wing flap cylinder piston seal leak –1; #3 pressure port seal leak–2; #2 pressure port flange seal leak–1; Right dual filter sump plug seal leak–1; Landing gear trim cylinder leak–1; Aileron power assembly control valves leak–1; Landing gear swivel lock cylinder leak–1; Right manifold port seal leak–1.

Fitting problems were divided between seven failed parts; three "B" nut leaks and three loose fittings.

Line troubles were represented by two cracked tube assemblies; five abrasion holes; four broken low-pressure lines; four broken high-pressure lines; a pressure line fitting leak; a line pulled out of a fitting and two failures of pump pressure hose.

● **Maintenance Skills**–All data given in answer to survey questions were highly statistical. There was no attempt to consider the human element in failures.

Had records been kept on parts improperly installed; fittings overtorqued by mechanics; lines and fittings damaged accidentally during installation–none of which would have been reported by mechanics–the record of line, fittings and seal failures doubtless would have been more moderate. Example: A manufacturer whose jetliners show an overall average (for all using airlines) of 7.87 parts removals per 1000 flight hours received from one airline, which has high standards of maintenance, a report of only 0.72 removals per 1000 flight hours. ▼▼▼

Nitrogen recharger mounted on semi-trailer

A trailer-mounted nitrogen recharger designed by The Cosmodyne Corporation, Hawthorne, Calif., supplies large volumes of high pressure gas from a self-contained, liquid nitrogen storage

Continued on page 146

IPC adds service time to your end product with "RULON"...*

the tested... filled fluorocarbon material for packings and oil seals

IPC now incorporates "RULON"* . . . a *filled fluorocarbon plastic material* . . . in packings, oil seals or precision molded products to answer your most critical sealing problems.

This new combination . . . "custom" molded and bonded for your specific application offers many advantages: Superior abrasion resistance, lower friction, improved sealing, less torque and reduced shaft wear.

Special molding and bonding techniques, developed by IPC for "RULON"* insure long wear and excellent performance. For your critical applications investigate the extras of IPC's latest "custom" approach! You'll find more benefits in handling increased pressures . . . higher shaft speeds . . . and temperature problems too!

Trade Name of Dixon Corporation.

IPC

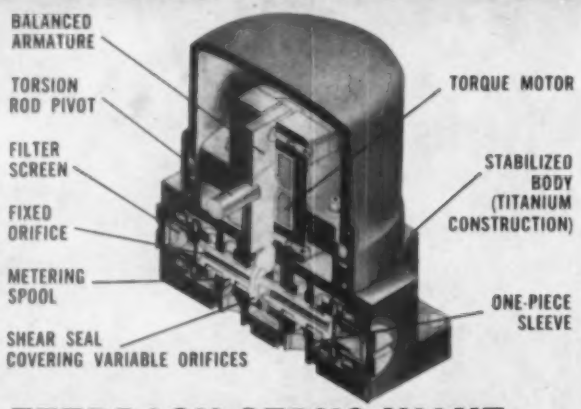
OIL SEALS / PACKINGS / PRECISION MOLDING *Custom designed for your application.*

INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

© IPC

P-3



A FEEDBACK SERVO VALVE WITHOUT SPRINGS OR LEVERS

- Unity coupled Hydromechanical Feedback
- High Null Accuracy
- Only 2 moving parts
- Large, full opening, shear-seal orifices

This two-stage, four-way flow control valve is the only one available that provides true positional feedback without springs or levers. The first stage consists of an electrical torque motor and "shear-seal" orifice hydraulic amplifier, while the second or control stage is made up of an accurately matched spool and sleeve arrangement.

Hydromechanical unity feedback relates spool position to torque motor armature position and also nulls out effects of orifice variations due to supply pressure and temperature fluctuations. Flow force reactions are thus substantially reduced and hydraulic centering of pilot position is feasible without spring hysteresis and null shift. Large orifices prevent clogging and silting and high shear forces permit efficient operation even with highly contaminated fluids. Final null adjustments are made electrically by a balancing control at amplifier output stage.

TYPICAL CHARACTERISTICS

	Medium Flow (#6103-#6105)	High Flow (#6104)
Rated flow	to 7.5 gpm at 3000 psi valve pressure drop	to 18.0 gpm at 3000 psi valve pressure drop
Hysteresis	3% maximum total rated current	3% maximum total rated current
Supply pressure	300 to 3000 psi	300 to 4000 psi
Proof pressure	4500 psi pressure port 3000 psi return port	6000 psi pressure port 3000 psi return port
Pressure gain	First stage—500 psi per ma minimum with 3000 psi supply	First stage—500 psi per ma minimum with 3000 psi supply
Load pressure gain	8500 psi per ma minimum with 3000 psi supply	10,000 psi per ma minimum with 3000 psi suoply
Temperature	−65°F to +275°F	−65°F to +275°F
Maximum Null Shift Temperature Change per 100°F	(% of rated current) 1%	1%
Supply Pressure Variation ±	2%	2%
Quiescent Current Change 20%	1%	1%
Weight	12 ounces	16 ounces

TORQUE MOTOR: Note: 6103 & 6106 identical with exception of torque motor characteristics.

	Valve #6103	Valve #6106
Input Power	300 Milliwatts	64 Milliwatts
Rated Current	± 10 ma	± 8 ma
DC Coil Resistance (other meters also available)	3000 ohms/coil	1000 ohms/coil

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.
Little Falls, New Jersey

Circle **95** on Reader Service Card

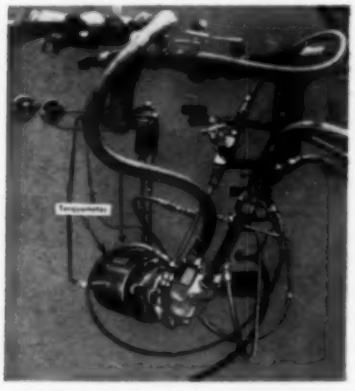
AEROSPACE NEWS

from the fluid power field

tank. The 1800-gal, vacuum jacketed, self-pressurized cryogenic tank is mounted on a 24-ft, step-flat-bed semi-trailer. The prime component of the recharger system is a high pressure liquified gas pump. It is a five-cylinder, fixed displacement pump with pistons driven by one-piece push rods in contact with a rotating, axial swash plate. The pump has three separate thermal sections that operate at ambient, intermediate, and cryogenic temperatures. Thermal isolation allows lubrication to take place at the warm end without lubricant freezing. The recharger pumps to pressures of 9000 psi.

Measuring torque on a hydraulic test stand

A pad type torque meter is used during production tests to evaluate hot fluid hydraulic pumps. Pad couplings, which meet AND specifications, support the pump and are used on the load end for ease



in rapidly changing pumps. High temperature torque meters manufactured by B & F Instruments, Philadelphia, are guaranteed to 350 F operating and 400 F non-operating. Standard temperature compensation maintains sensitivity constant to 1% or better per 100 degree F temperature change. Gauge factor is 50, resulting in a very high signal-to-noise ratio. Standard models cover torque ranges from 1.0 in.-lb. full scale to 30,000 in.-lb. full scale, and speeds to 50,000 rpm. ▼▼▼

Circle **159** →

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

For emergency needs call collect
MAnhasset 7-1800

ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

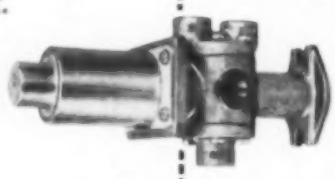
THOMSON INDUSTRIES Inc.
Dept. C-4, Manhasset, New York

PARTS HARDENED to 60 C...
increase life...reduce cost!

BLAMING COIL BURN-OUT ON THE SOLENOID? THEN TAKE A CLOSER LOOK AT THE **VALVE!**

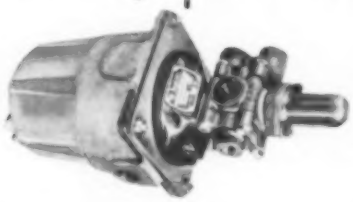
SPOOL and POPPET Valves bind and stick as dirt collects... overload solenoid and cause coil burn-out.

"SHEAR SEAL" Valves are not sensitive to dirt... always retain solenoid power margin.



D.C. SOLENOID "SHEAR SEAL" VALVES 0 to 10,000 P. S. I.

A.C. SOLENOID "SHEAR SEAL" VALVES 0 to 10,000 P. S. I.



EXPLOSION PROOF A.C. and D.C.

SOLENOID "SHEAR SEAL" VALVES 0 TO 10,000 P. S. I.

SPOOLS and POPPETS leak... can't compensate for normal wear.

"SHEAR SEAL" Valves stay leakproof... a spring takes up the normal wear.

Send for free Standard Valve Catalog 60-61

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle 18 on Reader Service Card

FLUID POWER PATENTS

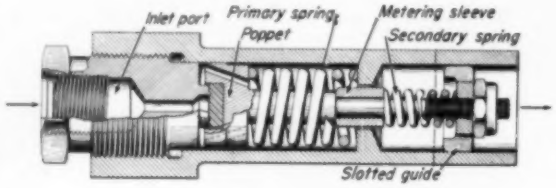
Quick Closing Relief Valve

To maintain close pressure control, this relief valve varies fluid pressure on top of the main relief poppet. By accurately regulating this pressure, the valve can be adjusted to reseat 98.5% of its relief pressure.

• **Metering Sleeve Controls Pressure**—When fluid pressure at the valve's inlet port overcomes force of the primary spring, the valve opens. Fluid flows through the port in the poppet into the primary spring chamber, and through the annular orifice around the metering sleeve to the outlet. Pressure drop across the annular orifice moves the metering sleeve right, against the force of the secondary spring.

As the metering sleeve moves out of its orifice, increased flow through the orifice reduces pressure in the primary spring chamber. This increases pressure drop across the poppet and opens the valve quickly.

On decreasing pressure, the metering sleeve moves back into the orifice. This movement reduces flow from the primary spring chamber. The resulting increased pressure in this chamber added to the primary spring force closes the valve quickly.



U. S. Patent No. 2,977,978 by M. N. Miller & Roy V. Smith, assigned to Fairchild Engine & Airplane Corp., Hagerstown, Md.

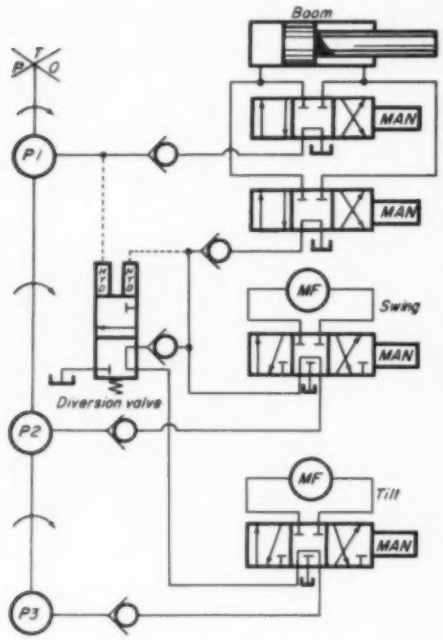
Priority Circuit

A special pilot-operated valve in this circuit directs the output from two pumps to join the output of a third pump when the pressure drops in the third pump's circuit. However if flow is being used it is not directed to the third pump's circuit.

The system is used on a grader. The boom cylinder is rotated and tilted by fluid motors. Pump P1 supplies the boom cylinder to raise and lower the boom.

Pump P2 supplies the swing motor, and pump P3 supplies the tilt motor.

Raising and lowering the boom cylinder is controlled by two valves, mechanically connected together to actuate at the same time. One of these valves con-



trols flow from pump P1. The other controls flow from pumps P2 and P3. When the swing control valve is in neutral, flow through the valve also passes through one of the boom cylinder control valves. Therefore, when the swing motor is not being used, flow from P2 is available for extending or retracting the boom.

Flow through the tilt valve in its neutral position passes through a diversion valve and then through one of the valves in the boom cylinder circuit. When the tilt motor is not being used, flow from pump P3 is also available for extending or retracting the boom cylinder.

The diversion valve has two hydraulic actuators at one end. Either of these actuators keeps the valve shifted as long as pressure is above a set value in the boom cylinder circuit. When the diversion valve is actuated, flow from pump P3 passes through it to tank until pressure drops in the boom cylinder circuit. When pressure falls to the set value, the diversion valve shifts and directs pump P3 output to the boom cylinder circuit.

If either the tilt or swing circuits are being used, flow from their pumps cannot be directed to the boom cylinder circuit.

The valves may be individual units or all mounted in a single manifold. The system is efficient because all pumps unload to tank through the tandem-center valves when not in use.

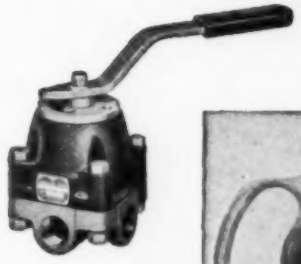
U. S. Patent No. 2,979,908 by W. M. Shook, assigned to Warner & Swasey Co., Cleveland, Ohio.

For High Pressure (to 10,000 P.S.I.)

MANUAL WATER VALVES

that last

Specify "SHEAR-SEAL" design



4-Way, Manipulator, Dual pressure and Shut-off Valves from ¼ to 1½" N.P.T.

Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

On extrusion presses, die casting machines, rubber and plastic molding presses and on blowout preventers, they have performed without maintenance longer than any other type of valve.

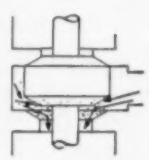
This LONG, MAINTENANCE-FREE SERVICE is possible because the metal-to-metal sealing surfaces are self-aligning and actually improve with use through continued lapping action. Sealing qualities do not diminish because a spring compensates for the wear.

DIRT CANNOT SCORE SEALS because flow is through "Shear-Seals," sealing surfaces remain in constant intimate contact.

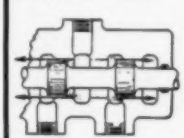
COMPLETE CONTROL OF YOUR CIRCUIT because "Shear-Seal" design is excellent for throttling. It permits opening to any desired degree of flow with smooth action and without fighting fluid pressure.

The "Shear-Seal" action eliminates line surges and the round tubular flow passages provide more flow and velocity capacity (up to 60 ft. per sec.) because they are unobstructed by spools or poppets.

This is why we don't use **SPOOL OR POPPET DESIGN**



Poppets score



Spools leak

Write for Catalog 60-61

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **19** on Reader Service Card

Circle **96** on Reader Service Card

NEW HEAVY DUTY TYPE KEBBY TANK-TRAPPER

. . . low cost magnetic unit for hydraulic reservoirs

- "DOUBLE MAGNETIZATION"
- CUTS MACHINE DOWN TIME
- REDUCES MAINTENANCE
- MORE DURABLE
- MASSIVE APPEARANCE

Write, wire or phone WO 3-1466 for information and prices.

KEBBY COMPANY
2320 Custer Ave. • Rockford, Illinois
MANUFACTURERS OF MAGNETIC DEVICES

NEW PRODUCTS

Continued from page 72

BAR STOCK FLOW VALVES

Two Teflon seats seal flow in both directions. Self-lapping and self-cleaning action gives perfect sealing and long life. Quarter-turn. Easily visible on-off indication.

Specifications: Sizes from ¼" to 2". Rated 1000-psi test. With NPT and AND threaded ends in carbon steel, 303 and 316 stainless steel, and brass.

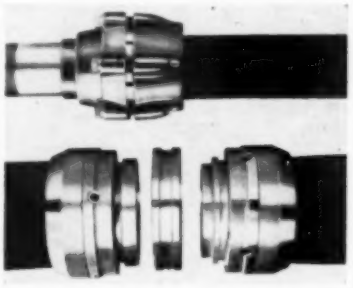
Designation: Flo-Ball.—*Hydromatics, Inc., Bloomfield, N. J.*

Circle **323** on Reader Service Card

HIGH PRESSURE HOSE COUPLING

Reuseable, high pressure hose coupling for use with wire-braided or spiral-wrapped hose. Coupling's holding power has not yet been determined because it exceeds the burst strength of the best hose available. Has positive mechanical grip, eliminates hose end preparation, accommodates all hose wall thicknesses, and is assembled with one standard wrench.

Coupling consists of a nipple with two floating collars presenting internal cam surfaces to mating cam angles on the oustide diameter of a wedge circle. As tension is applied to the floating collars through tensioning screws, the wedge is compressed at a 90-degree angle to the longitudinal axis. This eliminates scarfing of the hoses and uneven pre-tensioning of fabric or wire reinforcement. The



wedge tightens under hose pressure and prevents crimping of reinforcing wire.

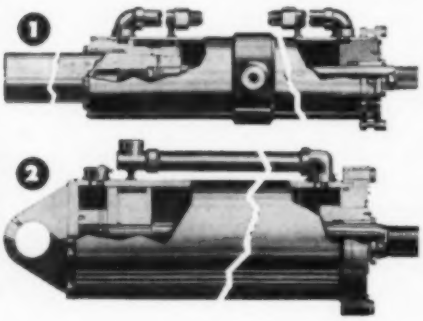
Continued on page 152

MUSCLES for the "TROJAN 404"...

As advertised in Construction Methods and Equipment; Materials Handling Engineering

Ward Hydronics gives these cylinders their heavy duty stamina in 4 ways

Look first at the cut-a-ways. Notice the clean, simple, trouble-free engineering design. No frills. Consider next Ward's use of high strength materials . . . stress relieved cold drawn steel tubes, tempered piston rods, high tensile steel trunnions, non-metallic bearings in piston area, MIG welds, to name a few. Add two more facts: tool and die shop standards of quality control, adaptation of standardized *proven* components to the specific requirements of the Trojan Tractor Shovel Model 404. • Ward Hydronics can do as much in muscling *your* machines. And remember, Ward Hydronics is organized and equipped to produce specialty hydraulic cylinders with rod diameters up to 9 inches, rod lengths up to 30 feet. We also do well by customers who need medium production runs of standardized cylinders. Write for brochure and blank quotation form. Ward Hydronics Incorporated, 11600 Genesee St., Alden, New York.

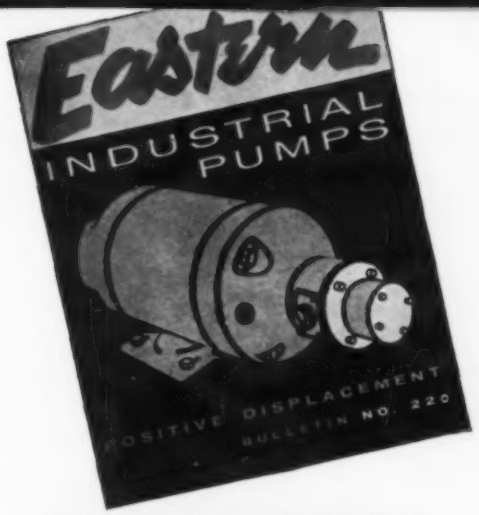


BUCKET CYLINDERS— 6-inch bore, 26-inch stroke, double-ended, double-acting

HOIST CYLINDERS— 9-inch bore, 36-inch stroke, single-packed, double-acting

Circle **167** on Reader Service Card

Circle **50** →



EASTERN takes the gamble out of selecting

POSITIVE DISPLACEMENT PUMPS

If you have a performance requirement for pumps which can deliver a pulsation-free flow of non-lubricating liquids at pressures up to 200 psi on the gear type or rates up to 6 gallons per minute on the vane type, pick a winner from the big Eastern line.

For small volumes against relatively high pressures, the Eastern GW series gear pumps are a natural. In each pump, oversized bearings of impregnated graphite support a drive gear of stainless steel and an idler of special bronze material. These self-priming units require no lubrication and cannot contaminate the liquid being pumped.

For volumes from 1.5 to 6 gpm and pressures to 60 psi, you can't beat Eastern VW series vane pumps. These highly efficient units are designed around a cam-shaped pumping chamber assuring pulsation-free liquid flow. Vanes are held in positive contact with the pumping chamber at all times — and their positioning is independent of hydraulic pressure or centrifugal force. Composition carbon graphite bearings and vanes require no lubrication beyond that of the liquid being pumped.

All Eastern positive displacement pumps are close-coupled with motor or can be furnished less electric motor with belt stand for belt or coupling drive.

Don't make your points the hard way — play safe and write for Eastern's new Bulletin 220 on positive displacement pumps.

Other Eastern products:

- ***hydraulic motors***
- ***gear pumps***
- ***centrifugal pumps***
- ***aircraft pumps***

EASTERN INDUSTRIES PUMP DIVISION

EASTERN INDUSTRIES INCORPORATED

Hamden, Connecticut

NEW PRODUCTS

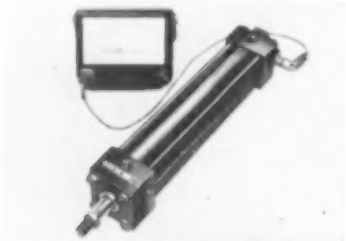
Specifications: For hoses from 1½ in. to 12 in. ID.

Designation: Power Grip.—*Consolidated Controls Corp., Annapolis.*

Circle **324** on Reader Service Card

ELECTROHYDRAULIC PROGRAMMING CYLINDER

Used in closed loop, hydraulic circuits actuated by servo valves. A signal developing transducer within the cylinder is pressure balanced



and is not affected by cylinder rotation or axis orientation. Constant feedback signal from transducer prevents overshoot and hunting, assures accurate duplication of programmed operation. Used for automating repetitive manual operations such as press feeding, parts removal, material handling, clamping, indexing, loading and unloading. Output signal can also be used to control remotely installed cylinders which actuate dampers, chutes, levers and other mechanical devices.

Designation: GUERIN 80.—*Guerin Engineering, Inc., Ferndale, Mich.*

Circle **325** on Reader Service Card

PNEUMATIC ROTARY ACTUATOR

Pneumatic actuator uses inclined ball race principle to convert piston action into rotary motion. Actuator is simple and sturdy. Piston and actuator each have three inclined raceways. When assembled, the three raceways provide a controlled path for three ball bearings. The piston moves in linear direction only, while the rotor plate is restricted to rotary travel. Pressure on the piston exerts a force on the ball bearings and the resultant vector forces from the inclined raceways make the rotor plate turn.

Specifications: Torque is 6.5 in. lb. Air displacement is .16 cu. in. Weight 15 oz. Overall size: 2 in. dia, about 2¾ in. high. Time required for a 90 degree stroke is 30 to 40 milliseconds depending on actuating pressure and load.

Designation: Series 50.—*Ledex Inc., Dayton, Ohio.*

Circle **326** on Reader Service Card

MINIATURE DIRECTIONAL VALVES

For small volume systems such as jig positioning and clamping, hy-

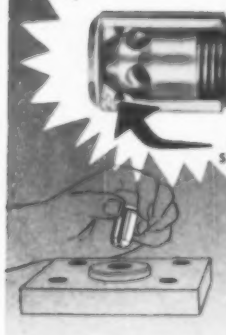
draulic gear shifting and clutching on machine tools, and venting on hydraulic system relief valves. Gas-

Continued on page 155

NEW! KEPNER Kepsel

cartridge-type valve insert

The Check Valve that cuts costs of Design and Installation 75% and more!



- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

*Patent Applied For

Write for complete technical data

KEPNER PRODUCTS COMPANY
7321 West 50th Street Summit, Illinois

Circle **98** on Reader Service Card

STANDARDS for INDUSTRY

Century Liquid Level Sight Gages

MODEL 8575 for Petroleum Base Fluids

MODEL 8575-NON for Polyester Synthetic Fluids

QUICK EASY mounting on any wall thickness

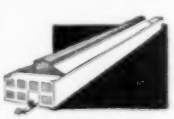
LARGE FACE—7" overall for excellent visibility

LEAK-PROOF—No Dripping

CENTURY LIQUID LEVEL SIGHT GAGE low cost and proven performance will amaze you

Write for dimensional literature

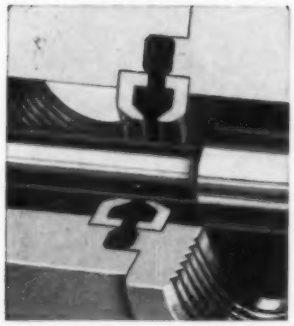
CENTURY HYDRAULICS
Division of Century-Detroit
6101 Concord Avenue • Detroit 11, Michigan
Telephone WAlnut 3-8088



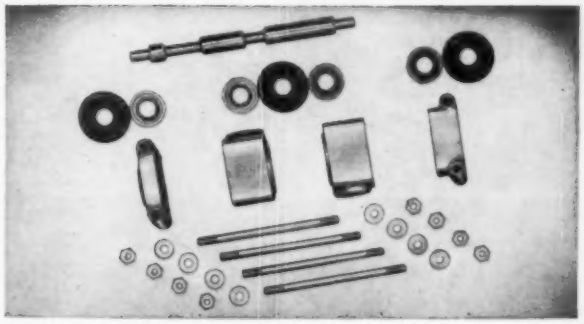
DESIGNERS & BUILDERS OF HYDRAULIC POWER UNITS PNEUMATICS, RESERVOIRS, HYDRAULIC ACCESSORIES & TEST STANDS

Circle **30** on Reader Service Card

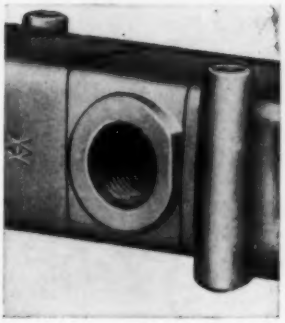
Do the air valves you buy include these quality features?



SEAL—Exclusive, triple-supported seals permit interference fit of spool for extra-tight closure with minimum wear. Usual damage to conventional "O" rings by moving spool is eliminated.



SIMPLICITY—Uncomplicated parts mean long life and easy servicing. Common parts are used extensively to simplify stocking or repair.



FLEXIBILITY—Modular Construction. Operators, mounting holes and ports may be independently rotated in 90° steps. Operator may be on either or both ends.

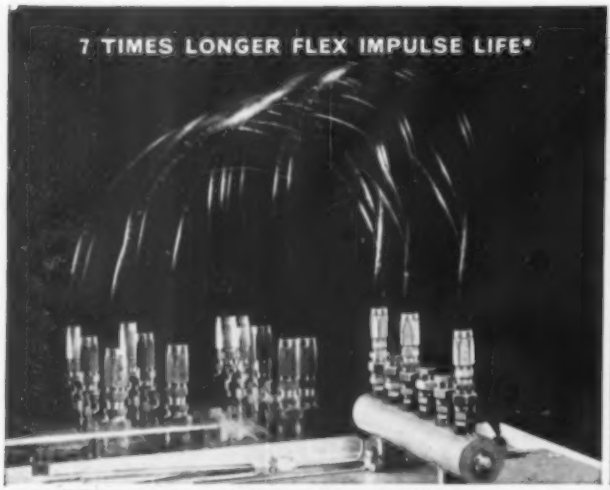
This high-quality "D" Pilotair® Valve is available in thousands of combinations. Tailored valves at standard model prices. Nine basic valves may have one or two of eight operators. Many types of spring return or holding functions.

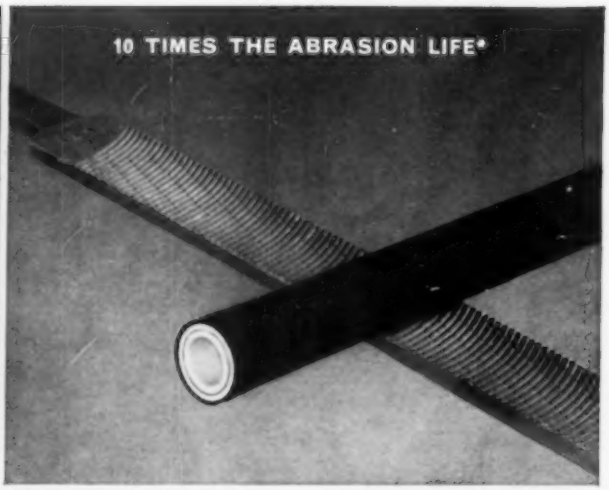
if not, the chances are your maintenance costs are higher than necessary. For more information about quality Fluid Circuitry Controls for trouble-free automation, ask for Catalog A4-75.01.

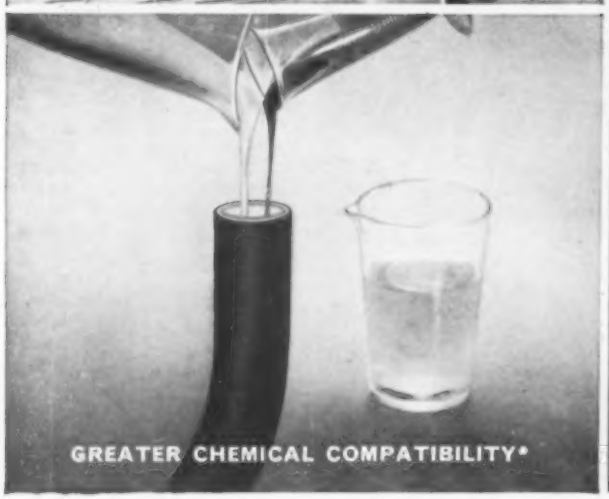
See the Yellow Pages under Cylinders for the Name of Your Local Distributor, or refer to Sweet's Catalog, Product Design File.

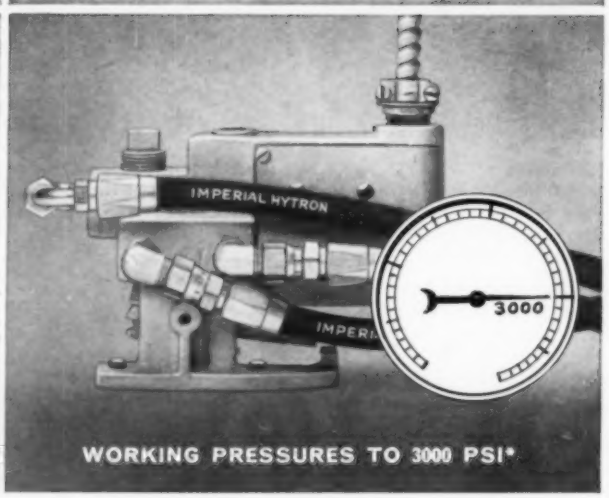
WESTINGHOUSE AIR BRAKE COMPANY

INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA









No wonder HYTRON® HOSE outperforms wire braid hose . . .

Hytron polyamide-polyester hose takes abuses that make other plastic and wire braid hoses fail. It's tough, durable, lightweight. Has 7 times longer flex impulse life than wire braid. It's versatile. Greater compatibility with mineral or synthetic fluids having a water or phosphate ester base gives Hytron a wider range of uses than other hoses. Available in long lengths, too—to 1000 ft. Some of the hundreds of applications especially suited to Hytron hose include:

Hydraulic lines	Non-conductive (electrical) applications
Hot paint lines	High-lines for electric power
Solvent lines	Fuel and oil lines

High pressure pneumatic and CO_2 lines

***Based on comparative tests with one-wire braid hoses.**

Find out how Hytron Hose can do the job better and save you money. Send for detailed report and test results—Bulletin NEPR-500.

IMPERIAL EASTMAN

Imperial-Eastman Corporation General Offices: 6300 West Howard Street, Chicago 48, Illinois

Imperial-Eastman Corporation (Canada) Ltd., Barrie, Ontario, Imperial-Eastman, S.A., Apartado Postal 26544, Mexico 13, D.F.

EXTRA-TOUGH
AND FLEXIBLE
1. Abrasion-resistant thermoplastic cover
2. Tough polyester reinforcement—no wires to fatigue
3. Clean, nonporous, seamless polyamide inner tube

it's thermoplastic!

- Highly flexible—minimum bend radius is only half that of one-wire braid hose.
- 60% lighter in weight than wire braid hose.
- Smaller O. D. than same size I. D. wire braid hose—reduces assembly bulk, permits use of more couplings in confined areas.
- More resistant to more chemicals at higher temperatures than standard hose. Resists sunlight, mildew, aging.
- Temperature ranges from −40° to 225° F.
- Low diametrical expansion.
- Over 200 times the torsional fatigue life of wire braid.
- Available in long lengths—up to 1000 ft. Sizes ⅛" to ½".

Hytron hose furnished as factory-made assemblies with permanently attached couplings, or with easy-to-install, re-usable couplings in a wide range of sizes and styles.

IMPERIAL — EASTMAN

Circle **90** on Reader Service Card

NEW PRODUCTS

ket-mounted. 4-way, single and double solenoid models.

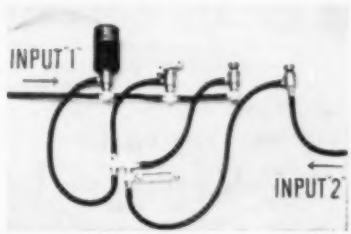
Specifications: To 1000 psi, 2 gpm. Alternate ¼" pipe thread cylinder port connections, opposite mounting face containing four normal port openings.

Designation: DIL.—*Vickers, Inc., Div. Sperry Rand Corp., Detroit.*

Circle **327** on Reader Service Card

MINIATURE SHUTTLE VALVE

Miniature shuttle or double-check valve for use in multiple circuitry of cylinders, controls, and safety devices. Alternate flow from two inputs to a single output, but never to another input is done with a sliding piston. Exhaust is always through the input port where pressure was last applied. Several shuttle valves can be joined together to actuate a cylinder with valves controlled by solenoids, cam followers or manual push buttons. Units especially useful for "inching" operations.

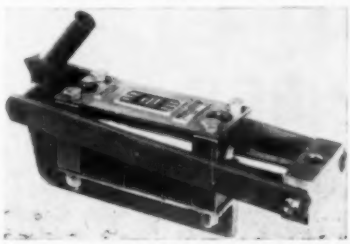


Specifications: Input ports tapped for 10-32 fittings. Pressure range .5 to 250 psi. Air flow rate 5 cfm at 50 psi.—*Clippard Instrument Laboratory, Inc., Cincinnati.*

Circle **328** on Reader Service Card

VARIABLE LEVERAGE HAND PUMP

Suitable for pressures from 1000 to 2000 psi. Toggle linkage gives



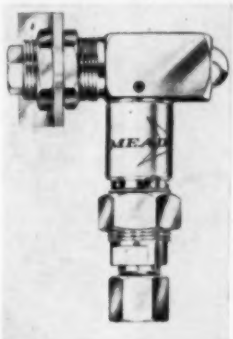
mechanical advantage up to 3.5:1 on the extending stroke when linkage approaches dead center. Hydraulic hand pumps also available for 3000, 5000, and 10,000 psi. Can be used on floor cranes, truck cranes, and other industrial applications.

Designation: Model 2098.—*Mechanisms Co., Uhrichville, Ohio.*

Circle **329** on Reader Service Card

ADJUSTABLE BLEED VALVE

Pneumatic pilot actuator bleeds only enough air to shift a master valve before closing itself automatically. Valve actuates differential pressure, master valves of the pilot bleed type. Bleed dur-



ation can be varied to meet circuit requirements which change with distance from master valve, master valve capacity, and actuation speed. Flow direction can be changed by another limit valve even while first valve remains depressed. Valve can be used in circuits where a limit valve plunger must stay depressed through a series of operating cycles.

Designation: No. 408 Interlock Limit Valve.—*Mead Specialties Co., Chicago.*

Circle **330** on Reader Service Card

DUAL-SEALING CONTROL VALVES

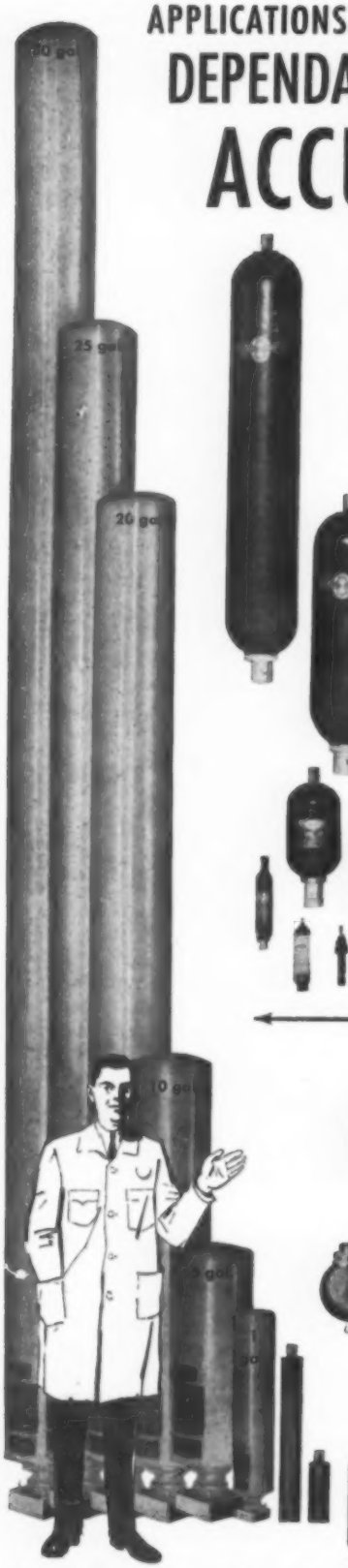
Lever- or pilot-operated dual sealing, 2-way hydraulic control valves for hydrostatic testing of tubing, pressure vessels, and other applications. Can hold rated pressure in both directions. Eliminate the need for additional external check valves. Suitable for pressures to 5000 psi. In high pressure system, valve can be closed and inlet pressure dropped with high pressure still held on the outlet side. High pressure on the outlet side can be intensified for testing without leaking or damaging the packing. Valve is designed to release pressure on

Continued on next page

APPLICATIONS UNLIMITED

DEPENDABILITY UNLIMITED

ACCUMULATORS UNLIMITED



Meeting engineering demands for 20 years has meant continual upgrading for the Greer Accumulator. Today's reliability, safety and service are the result of this unmatched field and operational experience. Engineering application and service are available from any of the 23 field offices, distributors or factory personnel. Bring your engineering problem on standard accumulators or special adaptations to Greer.

Friction Free Bladder Types

3000 psi, 8 sizes: 10 gal., 5 gal., 2½ gal., 1 gal., 1 qt., 1 pt., 10 cu. in., 1½ cu in. 6000 psi, 3 sizes: 10 gal., 5 gal., and 2½ gal. The only type of its design approved under ASME codes of unfired pressure vessels. Approved by Coast Guard and I. C. C. regulatory bodies. Meets J. I. C. regulations.

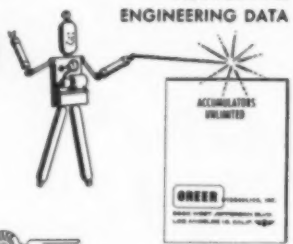
Floating Piston Types

3000 psi, 14 sizes: 30 gal., 25 gal., 20 gal., 15 gal., 12 gal., 10 gal., 5 gal., 4 gal., 2½ gal., and 1 gal.; 116 cu. in., 60 cu. in., 30 cu. in., and 10 cu. in.

Spherical Types

1000-3000 psi, 3 sizes: 10", 7" and 5" diameters

ASK FOR FULL ENGINEERING DATA



GREER HYDRAULICS, INC.

5930 West Jefferson Blvd., Los Angeles 16, California • UP 0-9161

Eastern Sales Engineering Office: 496 Grand Boulevard, Westbury, Long Island, N.Y. • ED 3-3700

Midwest Sales Engineering Office: 7331 North Ridgeway Avenue, Skokie, Illinois • OR 5-2693

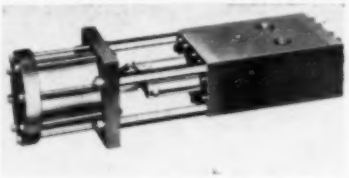
Distributors and representatives throughout the United States and Canada

Licensees in Germany, France and England

Circle **70** on Reader Service Card

NEW PRODUCTS

the packers, placing them in balance as the plungers shift. The packers float across the ports, mini-



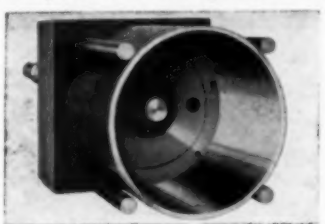
mizing wear, and providing maximum service life.

Specifications: Available in ¼, ⅜, 1, 1-¼, 1-½, and 2 inch sizes. Available pressure ranges are 2000, 3500, and 5000 psi.—*Hunt Valve Co., Salem, Ohio.*

Circle **331** on Reader Service Card

I.D. CHROMED CYLINDERS

Chrome plating prevents cylinder wear from misalignment between machine and cylinder. In tests, a weighted piston rod in a cylinder of 2½" bore, 12" stroke, destroyed an oxide-coated barrel within 10,000 cycles. A chrome-plated barrel



withstood the same test indefinitely. Side load caused by 50-lb weight in this test was more severe than normal cylinder loads.

Specifications: 200-psi air, 2500-psi hydraulic. Bore sizes from 1½" to 12".

Designation: Series R2.—*Hydro-Line Mfg. Co., Rockford, Ill.*

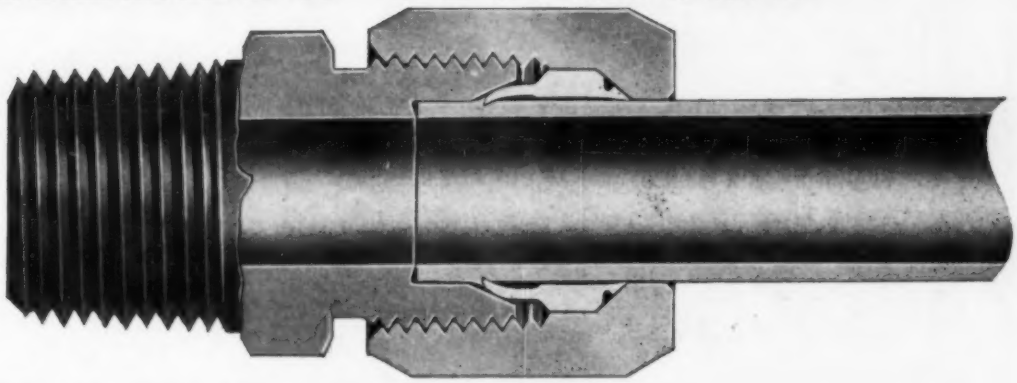
Circle **332** on Reader Service Card

POLYETHYLENE TUBING

Made to close specifications of high molecular weight, low melt index polyethylene resin. For air, gas, water, and chemical lines—either permanent or temporary hookups where low-cost, flexible connections are required. Tubing is not

Continued on page 158

ONLY PARKER "FERULOK®" FLARELESS FITTINGS



GIVE YOU DOUBLE SEALING ACTION

Built for heavy duty but ideal for standard tubing as well, Ferulok's visible bite means a safe, leak-proof connection which will hold well beyond tube bursting pressures. You can see this bite, inspect it . . . and *know* that you have safe make-up.

The same wedging action that seals ferrule to tube and ferrule to fitting body also results in a firm grip on the tube by the "heel" of the ferrule, damping vibration and preventing stresses from concentrating at the line of bite.

Made in steel, stainless steel and Monel, Ferulok meets, and actually exceeds, the performance standards set by S.A.E., J.I.C., and A.S.M.E. It also has Underwriters' Approval and meets federal specification MIL-F-5506 and BuShips specification MIL-F-21467 for hydraulic and air systems in Naval ships.

Get the complete story from your Parker-Hannifin distributor. You'll get engineering help and prompt deliveries as well. Check the Yellow Pages, or if you prefer, write us direct.

. . . WITH THE VISIBLE BITE

PARKER-HANNIFIN

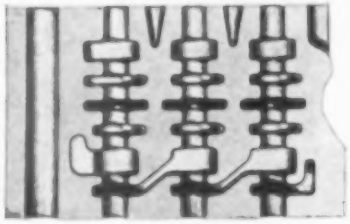
Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue • Cleveland 12, Ohio

PARKER HANNIFIN CORPORATION
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

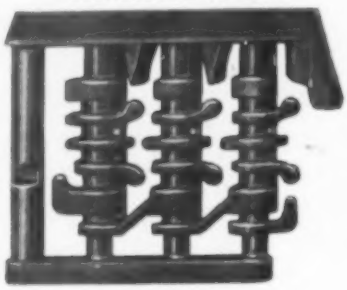
8000-P111 EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

Circle **40** on Reader Service Card

An improved product at minimum end cost with Dalton castings design assistance!



SECTIONED VALVE BODY



SHELL CORE

The Brown & Sharpe/Double A Mobile Valve is a versatile, electrically controlled hydraulic valve for modern mobile equipment. Dalton Engineers worked closely with the customer to develop a cast iron valve body with ideal performance characteristics at lowest possible cost.

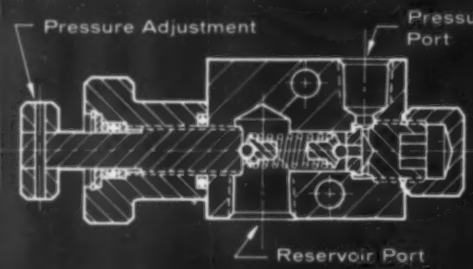
Intricate coring was necessary and Dalton's shell core facilities insured smoother, cleaner passages, greater accuracy. Exterior surface was contoured for even wall section thickness, and proper micro structure.

Dalton quality control maintains physical properties well above minimum requirements in this casting designed for Class 40 Gray Iron. Double A Products Co., Manchester, Michigan, is pleased with the results!

Specialization in pressure type castings with the engineering, production and quality control facilities to **guarantee the tensile strength requirement for the piece to be in the casting** . . . and give you an improved product at minimum end cost . . . leads us to reason that The Dalton Foundries is "Where Values Are Cast!" Write for brochure . . . see our specialist in hydraulic castings.

THE DALTON FOUNDRIES, INC., WARSAW, INDIANA

For Dependable Protection And Accurate Pressure Control



RELIEF VALVES

- **Protect cylinders from thermal expansion**
- **Control remotely operated relief valves**
- **Protect gages**

- Inexpensive
- No Leak
- Quick Acting
- Cracks and Reseats Accurately
- Tungsten Alloy Seats
- Wide Adj. Ranges: 0 to 500 psi 50 to 1,000 psi 500 to 4,000 psi — all
- Pipe Size ¼"

Write for detailed literature.

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

Fluid Controls, inc.

P. O. Box 186 • Mentor, Ohio • BL 5-3426

Circle **56** on Reader Service Card

NEW PRODUCTS

affected by most chemicals, including concentrated hydrochloric, sulphuric, and hydrofluoric acids. It is strong, tough, and has high stress-cracking resistance.

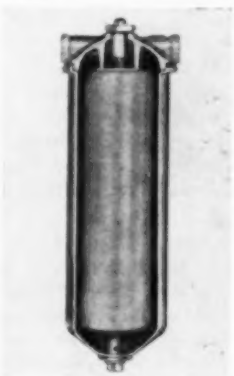
Specifications: Available in three sizes: ¼", ⅜", and ½" OD. Stocked in ¼" x .040" wall, and ⅜" x .062" wall in red, blue, green, black, orange, yellow, purple, and natural. All colors are fade-resistant. ½" OD available only in black and natural.

Designation: Synflex P-1.—*Samuel Moore & Co., Mantua, Ohio.*

Circle **333** on Reader Service Card

POROUS METAL FILTER ELEMENT

For lube and hydraulic systems in aircraft and missiles. Resists chemical action of corrosives and high temperature fluids. No media migration under conditions of vibration or thermal shock. Cleaned for re-use by firing, chemical, ultrasonic treatment, or back flushing.

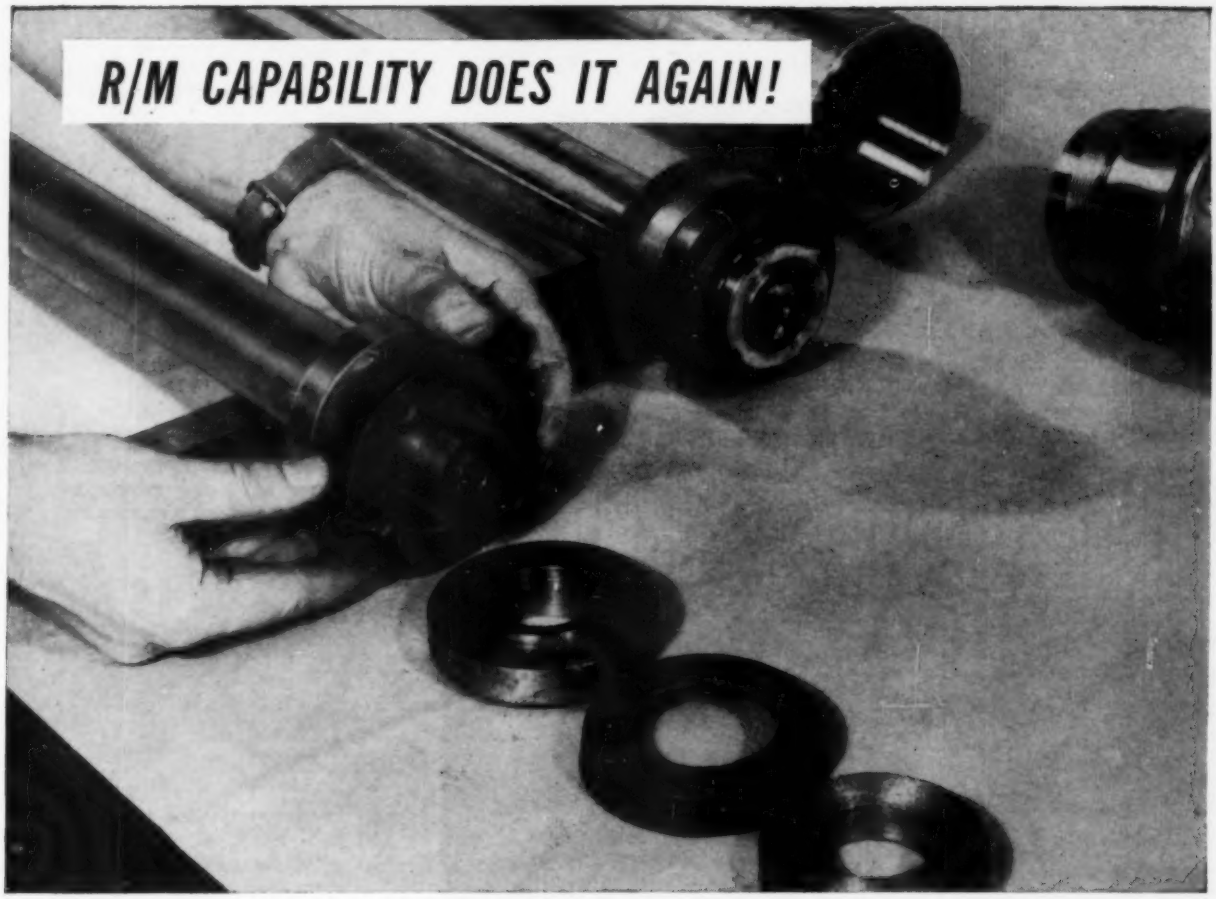


Specifications: In 10", 20", and 30" lengths, 2¾" O.D. Ratings of 40, 20, 10, 5, and 2 micron.

Designation: CFC—*Commercial Filters Corp., Melrose, Mass.*

Circle **334** on Reader Service Card

Continued on page 160



Solves major operating problems for tire press manufacturer with new Teflon*-impregnated molded asbestos piston cups

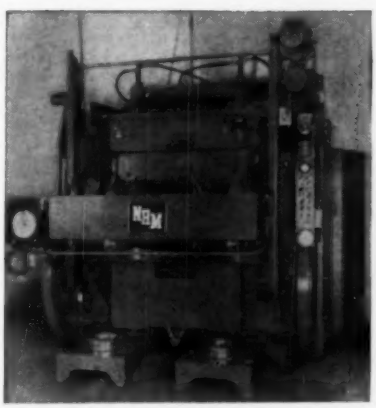
New molded asbestos piston cups impregnated with Teflon,* developed by Raybestos-Manhattan, Inc., have enabled National Rubber Machinery Company, Akron, Ohio, to improve the economy and efficiency of its Autoform Slideback Tire Press while realizing substantial savings. The new seal has not only reduced air loss to a minimum, but eliminated a lubrication system, cut maintenance, and increased machine operating life.

Before adopting R/M cups, NRM used metal rings for the ram and cylinder assembly. These did not provide the seal required, permitted a 5 to 10% air loss, caused excessive wear on moving parts, and required lubricants which were entrained, seeped into the molds, and damaged the tire rubber.

In considering a suitable replacement for the metal rings, NRM tested various synthetic rubber and leather cups. All deteriorated rapidly in temperatures up to 380°F. Then R/M was consulted. Preliminary investigation indicated asbestos with a Teflon filler as a potentially good combination for this application. Nearly a year of research, testing and engineering collaboration followed. Samples were developed and tested in the field under actual operating conditions. Only when all results were in—after two years—did NRM adopt R/M cups for use in all its presses.

R/M's experience in the manufacture of packings, gasket materials, and specialty products to meet the exacting and varied requirements of industry is at your disposal—whatever your need call on R/M.

Registered trademark for Du Pont fluorocarbon resins



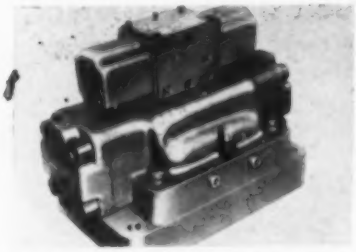
The application of R/M piston cups provided two important benefits. It eliminated oil in the curing room, preventing damage to the tire rubber. It reduced air loss with properly fitted and installed cups.

RAYBESTOS-MANHATTAN, INC.
PACKINGS
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

NEW PRODUCTS

FOUR-WAY, 5000-PSI VALVES

New 1-½", 4-way valve is rated for operating pressures to 5000 psi. Suitable for manual, mechanical, or electrical operation. Connection can be made with thread, subplate, or flange. Five different spool designs provide open, closed, or partially blocked flow path connections at flows up to 90 gpm. Valve has same basic design features as existing ¾" valve line.—*Denison*



Engineering Div., American Brake Shoe Co., Columbus, Ohio.

Circle **335** on Reader Service Card

DEPENDABILITY

THESE HANDS SHAPE the quality of hydraulic cylinders at CROSS Manufacturing Company. These hands sense the mettle of materials — deliver uncompromising machine artistry that promises dependability. These hands dare to test their skill with rigid, station-by-station inspection to assure conformity to the highest standards. For a hydraulic cylinder built to withstand severe pressures, corrosive atmospheres and violent stresses— look to CROSS — a complete line of reliable hydraulic cylinders for all industrial applications.

CROSS MANUFACTURING COMPANY

Lewis, Kansas / Phone EA 4-5525

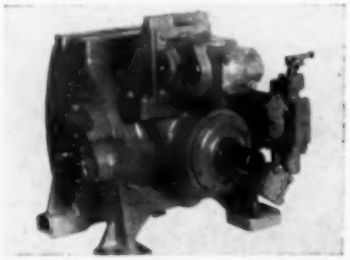
CROSS Engineers Available to You for Free Consultation!

Circle **39** on Reader Service Card

PUMPS, MOTORS 180 GPM, 5000 PSI

Angle type piston pumps and motors for pressures to 5000 psi. Fixed or variable displacement. Wide variety of controls, high-pressure capability, instant response to controlling signals, and reversible flow are features that make units useful in many applications: forming and extrusion presses, cargo winches, planer drives, and log carriages. With servo control, variable displacement pump can be stroked from maximum displacement in one direction to full opposite in about ⅛ second.

Specifications: Pump operation at 1200 rpm with atmospheric intake, at 1800 rpm with supercharging. Delivery at these speeds are 120 and 180 gpm, respectively. Maximum pressure is 5000 psi. Maximum displacement is 23.7 cu. in. per revolution. Maximum motor torque is 378 in. lb. per 100 psi.

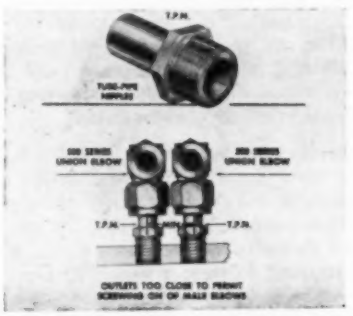


Designation: Series 120.—*Vickers Inc. Div. Sperry Rand Corp., Detroit.*

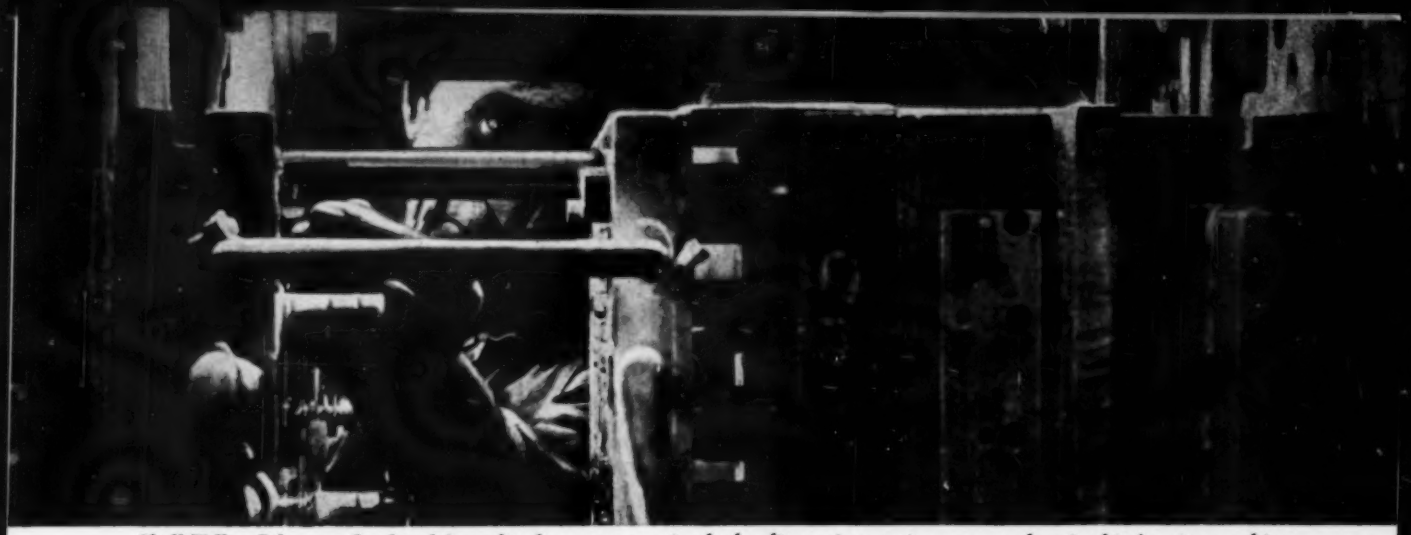
Circle **336** on Reader Service Card

TUBE-PIPE NIPPLES

Difficult piping layout and maintenance problems can be solved with O-Ring Seal fittings used with Tube-Pipe Nipples, TPN. Designed for use with elbows, tees, and crosses for easy positioning in desired directions. Solves close quarter fitting problems and eliminates the need for costly and special fittings.



Continued on page 162



Shell Tellus Oils are refined and formulated to meet exacting hydraulic service requirements, such as in this forming machine.

PHOTO COURTESY ATLANTIC PLASTICS INC., STAMFORD, CONNECTICUT

BULLETIN:

Shell provides a quick 6-point check list for hydraulic oils: Use it to pick the right oil for your needs

Selecting the proper hydraulic fluid for your equipment can be one of your most important decisions. And it can pay off in many ways. Less down time. Lower cost per unit. Longer equipment life.

Here are six bench marks to help you pick the best hydraulic oil for your plant requirements.

1. Does it have good oxidation stability? Oxidized hydraulic oil can form gums, lacquers and other deposits which may foul moving parts. Shell Tellus Oils are carefully refined to remove unstable, sludge-forming components, then fortified with a Shell-developed oxidation inhibitor.

2. Will it resist foaming and emulsification? Pump chatter and erratic operation are often the result of pump cavitation, brought on by oil foaming. Tellus® Oils contain powerful additives to help prevent foaming.

They also contain a selected inhibitor to combat effects of moisture that might be in the system.

3. Does it fight rust and corrosion? It is difficult to exclude all moisture from a hydraulic system. And moisture can form troublesome rust. Shell Tellus Oils have been carefully compounded to resist corrosion.

4. What are its lubrication qualities in continuous service? Shell Tellus Oils form a clinging, oily film on mating metal surfaces. This maintains a constant guard against wear.

5. How does it react to temperature changes? This is a key factor in the performance of hydraulic equipment. Careful selection of the proper viscosity grade of Tellus assures satisfactory operation of your system over its entire temperature range.

6. Is it available in several viscosity grades? Shell Tellus Oils are available in a broad range of viscosity grades. There's a special grade for virtually every hydraulic requirement.

Ask your Shell Industrial Products Representative for facts on Tellus Oils. Or write: Shell Oil Co., 50 West 50th St., New York 20, N. Y.

A message to manufacturers of hydraulic equipment

There is a Shell Tellus Oil suited for your equipment.

1. Your customers can get Tellus Oils at Shell depots everywhere. Readily available throughout the world.

2. Quality is consistently high. Tellus always delivers top performance.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

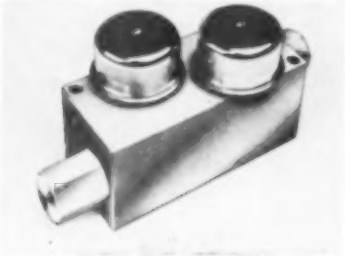
NEW PRODUCTS

Specifications: Fittings available from stock in full range from ¼ to 2 in. OD tubing. Wide range of lengths available. Any length made to order. Conforms to JIC specifications.—*The Lenz Co., Dayton.*

Circle **337** on Reader Service Card

DOUBLE FLOW REGULATOR

New double-flow regulator with detented dial adjustment has com-



plete pressure compensation, twelve position detents, dustproof dial adjustment, and bottom ports for easy installation. Valve incorporates two combination bypass and restrictive flow regulators in series in single block. Regulator can be installed in fluid power systems handling pressures up to 3000 psi that require manual adjustment of hydraulic fluid to two separate but associated functions.

Specifications: Valve has four ports: one inlet, two 0 to 15 gpm regulated ports, and a bypass port. Inlet and bypass ports are ¾" pipe, both regulated ports are ½" pipe. Flow from the bypass port can be independently used for system functions.—*Fluid Controls, Inc., Mentor, Ohio.*

Circle **338** on Reader Service Card

SUB-MINIATURE SOLENOID VALVE

For use in hydraulic and pneumatic circuits and control systems. Operates with all common media including many semi-corrosive fluids. Body and operating parts are stainless steel. Operating differential pressures from 5 microns vacuum to 150 psi pressures. Three-way NC valves are available in stock. Three-way NO directional control and two-way NO and NC valves available shortly. Coils in most a-c and d-c voltages and frequencies are standard. Housings available with choice of grommet or ¼" NPT conduit for electrical connections.

Specifications: Measures 1" dia x 2-¼" high, and weighs 5 oz. Orifices are 3/64". Connections are

all 1/16". All valves provided with fittings to adapt to standard 1/8" flared tube.

Designation: B Series.—*Skinner Electric Valve Div., New Britain, Conn.*

Circle **339** on Reader Service Card

Continued on page 165

"Dyflon"®
Self-Aligning
and
Self-Lubricating
SPHERICAL BEARINGS

Combine "Monoball"® Engineering Advantages with Life-Time Lubrication

Design engineers in many industries are specifying new "DYFLON"® SELF-ALIGNING and SELF-LUBRICATING SPHERICAL BEARINGS for these 5 major reasons:

1. LOWER COEFFICIENT OF FRICTION
...ideal where lubrication is impossible or undesirable.

2. WITHSTAND EXTREME VIBRATION
...perfect performance under shock load conditions.

3. WILL NOT "COLD-FLOW"
...even under extreme load conditions.

4. IMPERVIOUS TO KNOWN CHEMICAL SOLVENTS
...eliminates corrosion problems.

5. FAIL-SAFE ...due to "Monoball"® design.

Request Engineering manual No. 551.

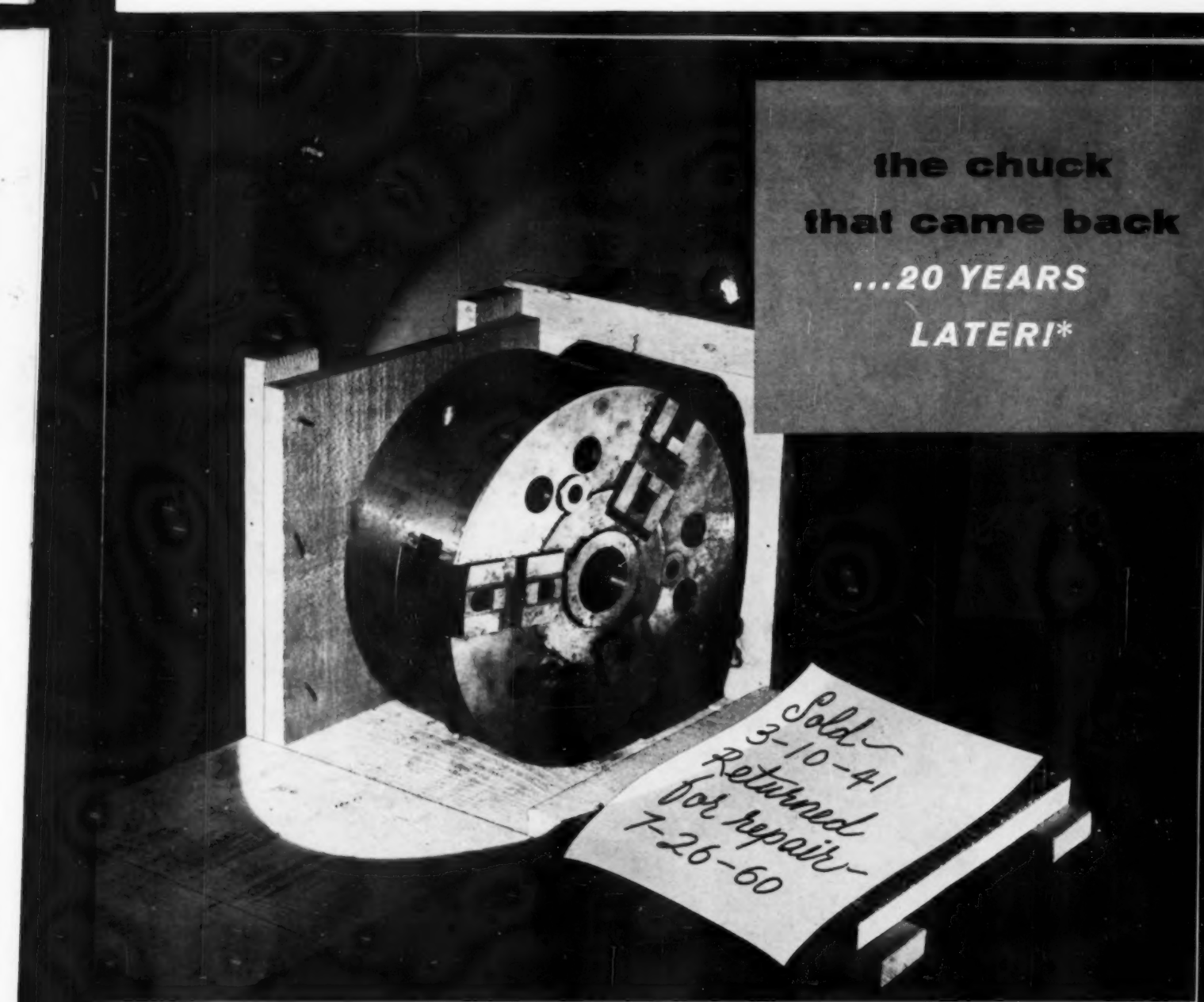
In addition, due to their two-piece "MONOBALL"® design and plastic alloy insert, "DYFLON"® bearings have a long cycle life. Alignment and installation problems are minimized. Oil-free for life means lowest possible maintenance costs.

Available in a variety of plain or rod end types. Bore sizes to 3.000". Materials include stainless steel, plastic alloys and chrome alloy steels. Ultimate static loads to 500,000 lbs.

SOUTHWEST PRODUCTS CO. 1705 SO. MOUNTAIN AVE. MONROVIA, CALIF. · PHONE: MURRAY 1-9616

Circle **153** on Reader Service Card

Circle **105** →



the chuck that came back ...20 YEARS LATER!*

This chuck was returned for refurbishing after 20 years of service!

Actually, this is not an out-of-the-ordinary service record for Logan chucks, because they are built throughout with extra factors of strength and durability to resist deflection, misalignment and wear—and to deliver accurate, dependable and efficient service year after year on any type of operation.

If you would like more information about these rugged, long-lasting air and hydraulic chucks, or any of Logan's other products, just fill out the coupon below.

**Customer's name furnished upon request.*

LOGAN
AIR AND HYDRAULIC OPERATED MACHINES

Check the items you want, fill in your name and address, tear out and mail to:

Logansport Machine Co., Inc. • 700 Center Avenue, Logansport, Indiana

___100-1 AIR CYLINDERS
___100-2 MILL-TYPE AIR CYLS.
___100-3 AIR-DRAULIC CYLS.
___100-4 AIR VALVES
___100-5 LOGANSQUARE CYLS.
___100-6 ULTRAMATION CYLS.
___100-7 SUB-PLATE AIR VALVE
___300-1 CHUCKS
___300-2 PRESSES
___200-1 HYD. POWER UNITS
___200-2 ROTOCAST HYD. CYLS.
___200-3 750 SERIES HYD. CYLS.
___200-4 and 200-7 HYD. VALVES
___200-6 SUPER-MATIC CYLS.
___ABC BOOKLET
___CIRCUIT RIDER
___CALCULATOR
___FACTS OF LIFE

Please send copy of catalog

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

OPENING NEW HORIZONS

. . . in economical power application

98% PLUS OPERATING EFFICIENCY
MORE POWER PER CYLINDER DOLLAR
PROVEN LEAKPROOF OPERATION
GREATEST SELECTION EVER OFFERED
SAFE UNDER SEVERE LOADS
SAFE WITH ALL KNOWN HYDRAULIC FLUIDS
SAFE UNDER TEMPERATURE EXTREMES
DAMAGE-PROOF PISTON RODS

Miller HYDRAULIC CYLINDERS

Flick-Reedy . . . *Winner of "Plant of the Year" Award and "Silver Anvil" Public Relations Award*

Miller

MORE SAVINGS!

Our ultra-modern, new "Plant of the Year" with its special facilities and operating economies enable us to offer an **extra 10% price savings** on our big "stock" selection of:
Model "H" (Hyd.) Cylinders, 1½" through 8" bores;
Model "J" (Hyd.) Cylinders, 1½" through 14" bores;
Model "A" (Air) Cylinders, 1½" through 14" bores.
Strokes up to 36", cushioned and non-cushioned.

Full Details On Request

Miller Hydraulic Cylinders make impossible applications look easy. With Teflon Seals, Case-Hardened Rods (50-54 Rockwell C), Patented "Shef" Tubing End Seals, and other exclusive *standard* features, these cylinders are practically damage-proof, are ultra-dependable under pressure and temperature extremes, and provide leakproof sealing with ALL hydraulic fluids. Built to *exceed* J. I. C. Specifications, these cylinders are achieving new highs in production and operating economies in thousands of plants. Two great lines: Power-Packed Model H for 3000-5000 psi and Job-Rated Model J for 500-2500 psi. All bores, strokes and mounting styles. Big "Stock" selection for immediate shipment at substantial savings.

Write for literature.

R

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

7N017 York Road, Bensenville, Illinois

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

PRODUCT BRIEFS

SHAFT OIL SEAL . . . The CRS seal features design improvements and sealing members molded of Sirvene compound (synthetic rubber) a Buna-N-based material. It's available in four standard configurations for shaft sizes ranging from ½" to 7".—*Chicago Rawhide Mfg. Co., Chicago.*

Circle **340** on Reader Service Card

THREAD LUBRICANT . . . Ferulube compound reduces wrench torque as much as 75% in the make-up of "bite" type tube fittings. Protective film prevents galling in stainless steel parts.—*Parker Fittings & Hose Div., Parker-Hannifin Corp., Cleveland*

Circle **341** on Reader Service Card

DIRECT-ACTION GAGES . . . Compact hydraulic gages, calibrated in 0-500, 0-1500, 0-3000, and 0-5000 psi ranges, operate on positive, direct-action principle. Spring-loaded pressure sensing mechanism is protected from shock and overloads.—*A. Schrader's Son, Div. Scovill Mfg. Co. Inc., Brooklyn.*

Circle **342** on Reader Service Card

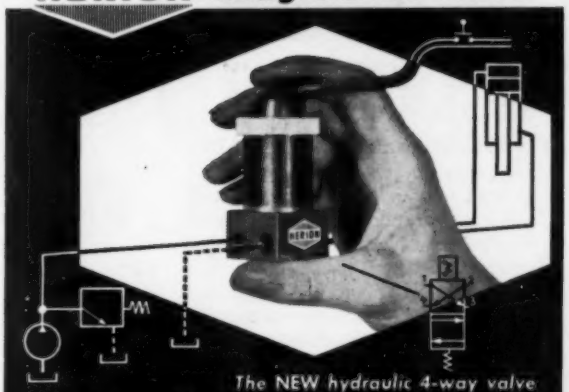
VALVE-IN-HEAD CYLINDERS . . . Type BVT cylinders are available in bore sizes 1½, 2, 2½, 3, and 4"; and in lengths up to 80." There is a choice of mounts as well as 48 valve-in-head cylinder models for the power section.—*Allenair Corp., Mineola, N.Y.*

Circle **343** on Reader Service Card

▼▼▼

Circle **82** on Reader Service Card

HERION Midget Slide Valve



The NEW hydraulic 4-way valve engineered for increased efficiency with great savings of space, weight and maintenance.

ESPECIALLY DESIGNED for Clamping Operations, Latch & Lever Systems, Lubricating Systems, Feed Operations, Oscillating Motion Control and similar functions.

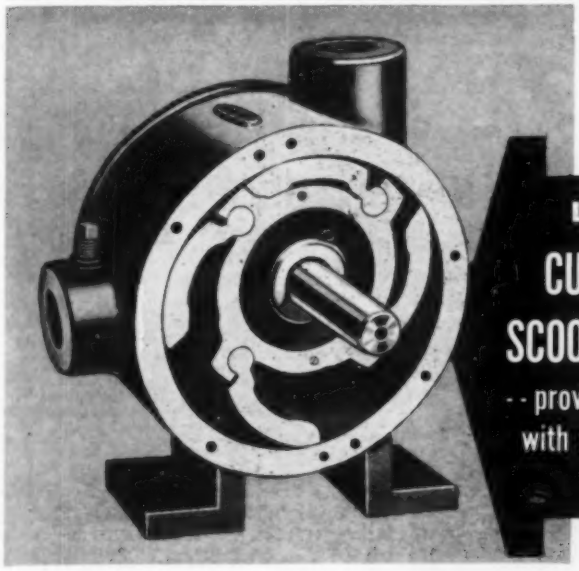
SPECIFICATIONS: Solenoid operated — 6, 12 or 24 Volt DC; Working Pressure — up to 1400 psi; Weight — 13 oz.; Pipe Size — ⅛ x 27 NPT; Built-in filter; Maximum flow Volume — 1 GPM; Overall length including cap — 3½"; Width — 1⅛" square.

HERION INCORPORATED

At the Service of Automation

P O BOX 184 VALLEY STREAM, N Y

The BIGGEST SCOOP in AIR PUMPS!



LEIMAN

CURVED VANES SCOOP UP MORE AIR

-- provide high capacity with slower speeds and less wear

• Four curved vanes scoop up large volumes of air—provide 2 to 3 times more air space. Mounted on easy-action hinges to assure perfect contact with cylinder walls by centrifugal force. Vanes and cylinders made of durable cast iron (no composition). Hone themselves to hard, glassy smoothness to assure leak-proof seal and reduce frictional wear. Negligible wear is automatically taken up by rotating vanes.

SEE OUR CATALOG S SWEET'S FILE

Write for new catalog showing construction, types, sizes and specifications, plus Application Book containing many "how-to-do-it" blueprints.

Leiman Air Pumps maintain new-pump efficiency and fully-rated vacuum or pressure for the life of your equipment, with little or no maintenance or repair. Fewer moving parts—no gaskets or packing—no composition vanes to wear out or renew. Pulseless airflow—every pump tested. Many models and sizes to meet your needs. Over 70 years' air engineering at your service on any design or application.

LEIMAN Rotary Positive AIR PUMPS

Vacuum to 29.9 Hg Pressure to 20 p.s.i.g Volume to 162 c.f.m.

LEIMAN BROS., INC., 151 Christie St., Newark 5, N. J.

Established 1889

NEW LITERATURE

Continued from page 76

MOLDED PACKINGS

Catalog presents the full line of packings for maintenance of presses, pumps, compressors, and other hydraulic and pneumatic equipment. New data gives detailed assistance in selecting the correct packing for each application. A featured addition is a series of shallow cross section packings now made for shallow stuffing boxes. A table lists types of molded packing recommended for the items in an extensive list of common machinery. (MP-361)—*Greene, Tweed & Co., North Wales, Pa.*

Circle **413** on Reader Service Card

VACUUM PUMP & AIR COMPRESSOR SELECTOR

Set this slide rule at the required air flow in cfm at 0 psig and a choice of rotary air pump models is indicated. Setting pointer on opposite side of selector then gives you the motor horsepower requirements and complete air flow characteristics over the range of 0" to 28" Hg vacuum or 0 to 30 psi pressure.—*Gast Mfg. Corp., Benton Harbor, Mich.*

Circle **414** on Reader Service Card

AIR-OPERATED HYDRAULIC PUMPS

Brochure describes hydraulic pumps that are air operated. They are specially engineered for high pressure hydraulic testing or powering of equipment, and are for oil or water service. Two series are available: ten models for 500 to 25,000 psi hydraulic pressure and eight models for 1000 to 30,000-psi hydraulic pressure (maximum air pressure 10 psi). Complete specifications are provided. (200)—*SC Hydraulic Engineering Corp., Los Angeles.*

Circle **415** on Reader Service Card

INDUSTRIAL O-RINGS

Described in this brochure are four compounds especially designed for O-rings to be used in general industrial sealing applications. Physical properties of these Buna-N and Neoprene compounds are shown as to shore durometer hardness, tensile strength, and elongation. Also listed are diaphragms, permadized seals, still-seal gaskets, and custom molding. —*Stillman Rubber Co., Culver City, Calif.*

Circle **416** on Reader Service Card

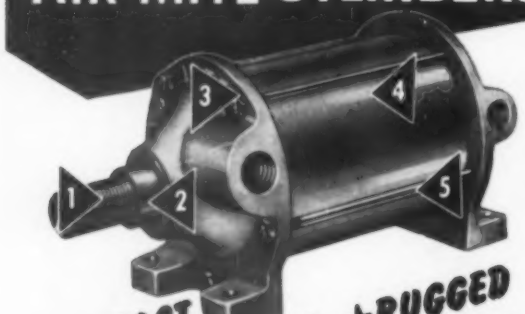
PILOT-OPERATED AIR VALVES

Three new air valve models capable of filling and exhausting a 100 cu in. load chamber from 0 to 90 psi in 0.150 seconds are described in this bulletin. Momentary contact and maintained contact solenoid models, as well as a remote pressure operated valve are offered in ⅜", ½", and ¾", pipe sizes. In addition to the new units, a companion line of bottom and side ported bases are described. (0611-B1)—*Hannifin Co., a Div. of Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **417** on Reader Service Card

Continued on page 169

AIR-MITE AIR CYLINDERS



★COMPACT ★POWERFUL ★RUGGED ★LOW COST

AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:
1 Ground and polished steel ram
2 Bronze oilless ram bushing
3 High strength aluminum alloy cylinder heads
4 Brass, true-bore cylinders
5 Five steel tie rods

92

AIR-MITE DEVICES, INC.
4301 W. Kinzie St. Chicago 24, Ill.

Circle **5** on Reader Service Card

MARSHALSEA
specialise in the manufacture of
Valves and Filters
for Hydraulic & Pneumatic Equipment

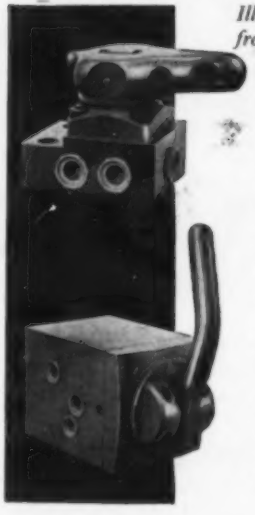


Illustration shows two examples from the wide range of valves

MBL.3128/1 (Top)
- 2-way selector valve feeds pressure to selected service (e.g. double-acting ram) leaving alternate selector position open to exhaust
- Selector handle in neutral position opens both selector connections to exhaust
- Other selector arrangements designed to customers' requirements

MBL.3485 *Prov. Pat. No. 34977/59* (Bottom)
- Single lever-operated valve actuates set of 4 chocks or single acting rams in pairs or sets of 4
- Separate selector valve incorporated to operate double-acting ram
- All operations, both pressure and exhaust, controlled by single selector lever
- 2 relief valves yielding at 6,500 p.s.i., fitted to valve body or installed separately
- Normal fluid — water and soluble oil

Full details gladly supplied on request.

MARSHALSEA BROS. LTD • TAUNTON • ENGLAND

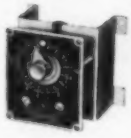
An A.I.D. Approved Inspection Organisation

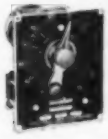
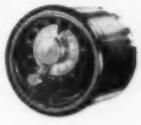
Circle **110** on Reader Service Card

Circle **91** on Reader Service Card

TIMING CONTROLS

PRECISION ENGINEERED

FOR ANY **TIME**  **DELAY**

 YOU NEED... 

FROM 1 SECOND TO 3 HOURS
Write for Bulletin 300 describing
8 different types.

INDUSTRIAL TIMER CORPORATION
McCarter Highway, Newark 4, New Jersey
Canada: Sperry Gyroscope Ottawa Ltd.,
3 Hamilton Ave., Ottawa, Can. • PA 8-4681

MOELLER HIGH-SPEED ADJUSTABLE CLOSURES

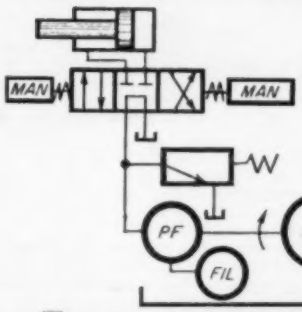
Fit any size or shape opening

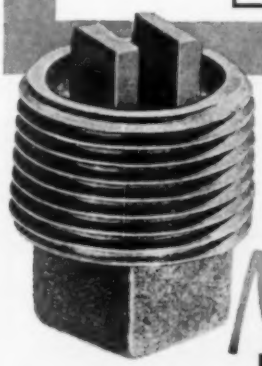
The patented adjustable action of Moeller's Snap-Tite® and Turn-Tite® cam and lever type action closures makes it possible to design a low-cost stopper in virtually any size or shape.
Made of cold-rolled or stainless steel and high-grade neoprene, or other specified materials, these new closures offer many opportunities to cut costs in product design, labor, time and assembly. For additional information, write . . . Industrial Division, Dept. 37.

MOELLER MFG. CO., INC.
Greenville, Mississippi

Circle **114** on Reader Service Card

REDUCE PUMP WEAR & FOULED VALVES





with **LISLE** *Magnetic* **PLUGS**

Controlled tests have proved that Lisle Magnetic Plugs increase pump life up to 300%, and greatly reduce the problem of fouled valves.

A Lisle Magnetic Plug, installed in the flow path or sump, picks up any ferrous metal particles in the fluid. Removal of these particles eliminate a primary cause of pump wear and fouled valves.

LISLE *Write for Catalog and Test Samples.*
CORPORATION
CLARINDA • IOWA

Circle **104** on Reader Service Card

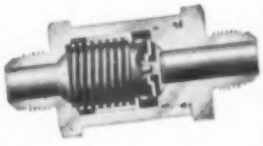
REPUBLIC VALVES
FOR EVERY INDUSTRY

CHECKS
THAT FILL YOUR NEEDS

MINIATURE CHECKS

Mini-Valve — Regular Size Valve

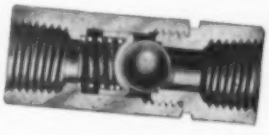
Save weight and space with Mini-Valves. They have same rated flow as regular size, but are only ¼ the size and weight. Good pressure drop characteristics. Temp. range −65° to plus 400°F. Operating pressure to 5000 psi. One-piece stainless steel body, in tube sizes 4 to 16 (¼" to 1" O.D.) Meets or exceeds requirements of MS MIL-V-25675. Port threading MS33514 flareless.



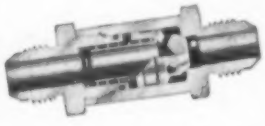
FREE-FLOW CHECKS

Extremely low pressure drop, with wide open flow. Molded elastomer seal and spherical seat prevent leakage at any pressure. Sizes ⅛" to 2" in brass and aluminum alloy up to 3000 psi, and stainless steel to 4000 psi. Opens at 2 psi. Temp. range −65° to 200°F. Pipe, internal straight thread and flared tube connections standard; MS33514 flareless available.

BALL CHECKS



Ruggedly constructed for intermittent non-shock hydraulic service up to 500 psi at temperatures −65° to 350°F. Sizes ⅛" to ¾". Brass, aluminum alloy, stainless steel. Pipe and flared tube connections.



HY-PRESSURE CHECKS

Built for continuous service in high velocity systems at pressures up to 5000 psi in steel and stainless steel, and 3000 psi in aluminum alloy. Low pressure drop. Metal-to-metal seal. Operating temperatures −65° to 250°F. Sizes ⅛" to 2", with pipe, internal straight thread and flared tube connections. MS33514 flareless available.

Distributors in principal cities coast to coast

CHECK RELIEF SELECTOR GLOBE NEEDLE PLUG

RM REPUBLIC MANUFACTURING CO.

15685 BROOKPARK ROAD • CLEVELAND 35, OHIO

Circle **139** on Reader Service Card

Circle **89** on Reader Service Card

NEW!

HYDRONIC
REMOTE CONTROL SYSTEM

PRECISE MANUAL MOTION DUPLICATION UP TO 100 FEET AWAY

Ideal for smooth, positive control of valves, variable displacement pumps, etc.

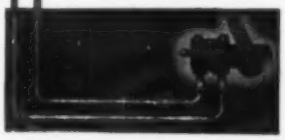
The HYDRONIC System is a distinct advance in the remote control field. It offers all the advantages and simplicity of a self-contained hydraulic system—as smooth and reliable as the brake system on your car.

Master and slave maintain synchronization through 114° arc with 500 in. lbs. output even under wide temperature changes. Simple adjustment permits instant relative positioning between master and slave.

Backlash, motion inaccuracies and installation difficulties inherent in mechanical linkages or push-pulls are eliminated.

Write today for complete information.

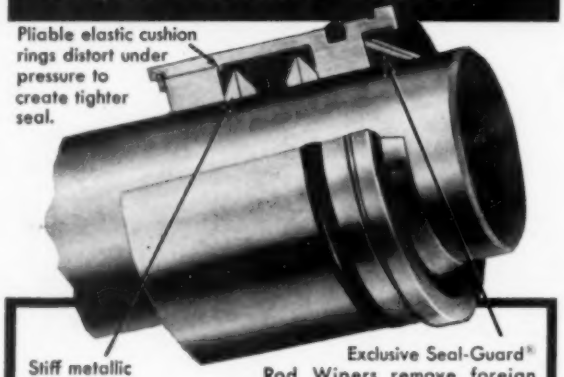
Sales Representatives: Some territories available—write for details.



HYDRONIC CORPORATION

12685 Arnold Avenue
Detroit 39, Michigan

WHY MONOPAK® CARTRIDGES OUT-PERFORM OTHER PACKING UNITS!



Pliable elastic cushion rings distort under pressure to create tighter seal.

Stiff metallic sealing rings

Exclusive Seal-Guard® Rod Wipers remove foreign particles from rod.

● Combines all essential packings, bearings and rod wipers in one complete package. ● Low friction coefficient for longer service life. ● Tamper-proof, shock and burst-proof. ● Needs no machining—easily installed or replaced. ● Trouble-free; cuts machine down-time.

Detailed literature on request.

HA HYDRAULIC ACCESSORIES CO.

24301 Hoover Road, Warren Mich.

Circle **87** on Reader Service Card

NEW LITERATURE

INTEGRAL AIR PUMP, MOTOR

For vacuum and pressure, 12 cfm. Can be used continuously for many years. Automatic lubricator does not require attention other than refilling. 27" vacuum continuous, 15-psi pressure. Automatic thermal overload protection. Inlet air-filter. Outlet vapor filter and silencer.—*Leiman Bros., Inc., Newark, N. J.*

Circle **418** on Reader Service Card

FLUID CONTROL VALVES

Outlined in this form are 3 and 4-way fluid control valves that feature directional control with built-in flow control. They are for use with vacuum, air, and oil. Principles of operation are shown through line drawings, cut-aways, and descriptive copy. Flow characteristics are shown on a typical performance curve chart. (V-200) —*Gabriel Valve Div., Gabriel Co., Cleveland.*

Circle **419** on Reader Service Card

PRESSURE SWITCHES

Light weight pressure and differential pressure switches which actuate at extremely low pressures are covered in Bulletin E7. Operation of adjustable Deltadyne signaling devices is described and data are included on standard and optional materials, accessories, ports, and fluid service. Drawings and complete ordering information is given.—*Pall Corp., Glen Cove, N. Y.*

Circle **420** on Reader Service Card

GASKET MATERIALS

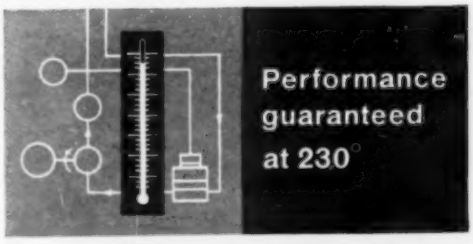
Resistance ratings of 120 fluids and gases. Technical data charts outline 25 standard rubber styles, 8 standard styles of cloth for gasketing—14 for diaphragms, 9 styles of compressed asbestos sheet, 4 of woven asbestos, and 5 standard styles of vegetable fiber sheet. Brochure AD-190.—*Garlock Inc., Palmyra, N. Y.*

Circle **421** on Reader Service Card

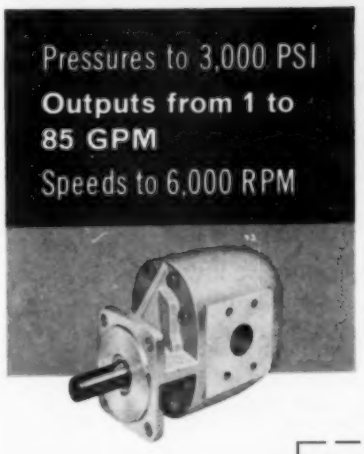
Continued on next page

BERRY/DOWTY* gear pumps

The Berry/Dowty line of hydraulic gear pumps has been subjected to exhaustive endurance tests. A Model GPA3/170 (rated output 24.5 GPM at 1800 RPM and 2000 PSI) was put through a one million cycle 0-2000 PSI test, with the final 200,000 cycles at 230° F. There was no measurable wear as a result of this test. In this and other tests, volumetric and mechanical efficiency has increased slightly from beginning to end of test, a result of the self-compensating design.



Performance and warranty are unaffected by system temperatures of 230° F. provided minimum operating oil viscosity is 50 SSU. Volumetric efficiencies of 95% at 2000 PSI are normal under these conditions.



Value analysis (price, performance and reliability) proves the economy of Berry/Dowty Hydraulic Gear Pumps. Wire or phone today (Corinth, Miss., ATlantic 6-5541, Dept. K) for test units for evaluation on your equipment.

Berry HYDRAULICS
A DIVISION OF OLIVER TYRONE CORPORATION

MAIL FOR NEW GEAR PUMP CATALOG
Berry Hydraulics Corinth 1, Miss.
Name_____
Company_____
Address_____

*Dowty is the trademark of Dowty Hydraulic Units Limited, England

Circle **25** on Reader Service Card

NEW LITERATURE

FLEXIBLE COUPLINGS

Engineering and descriptive data are given for three types of a new flexing-member coupling. Type DE Gearflex couplings are also covered. The new units are designed around the flexing characteristics of a new non-metallic material. This synthetic has an ideal modulus of elasticity and a high flexural fatigue strength. The new units are available for shafts from ⅜" to 3⅜" and for hp/100 rpm requirements from 0.3 to 29. —*Lovell Mfg. Co., Erie, Pa.*

Circle **422** on Reader Service Card

AIR & HYDRAULIC CYLINDERS

Heavy duty air and low pressure hydraulic cylinders are specified in this brochure. Engineering data is provided on cylinder action, rods, ports, seals, cushions, and piping. Complete mounting data is given for all cylinders by dimensioned line drawings. Piston rod end styles are also shown. (A-101)—*Milwaukee Cylinder Co., Cudahy, Wis.*

Circle **423** on Reader Service Card

PUMPS, BOOSTERS, MOTORS

Catalog gives complete data on this company's rotary positive air pressure and high vacuum pumps, gas boosters, and air motors. Pumps provide vacuums to 29.9 Hg., pressures to 20 psig, volumes to 162 cfm. Included are details of construction, dimensions, capacities, performance curves, plus helpful engineering and installation data. (561)—*Leiman Bros., Inc., Newark.*

Circle **424** on Reader Service Card

SOLENOID VALVE

Bulletin outlines 2-way solenoid valve capable of withstanding vibration of 20–1000 cps at 10G level without shifting position. Units are designed for normally closed operation at pressures to 1000 psi. This valve is supplied in ¾" NPT pipe size. It will handle fluids at temperatures from −65 to 150 F; may be mounted in any position. (V5128)—*Automatic Switch Co., Florham Park, N.J.*

Circle **425** on Reader Service Card

VARIABLE VOLUME PUMP

Uses movable-cam-ring principle to adjust hydraulic pump volume automatically. Model 6-1000 has spring to maintain constant pressure over output range from 0 to 6½ gpm at pressures set from 500 to 1000 psi. Model 6-500 is identical with a spring for constant pressure set between 0 and 7 gpm, 200 to 500 psi.—*The DoAll Co., Des Plaines, Ill.*

Circle **426** on Reader Service Card

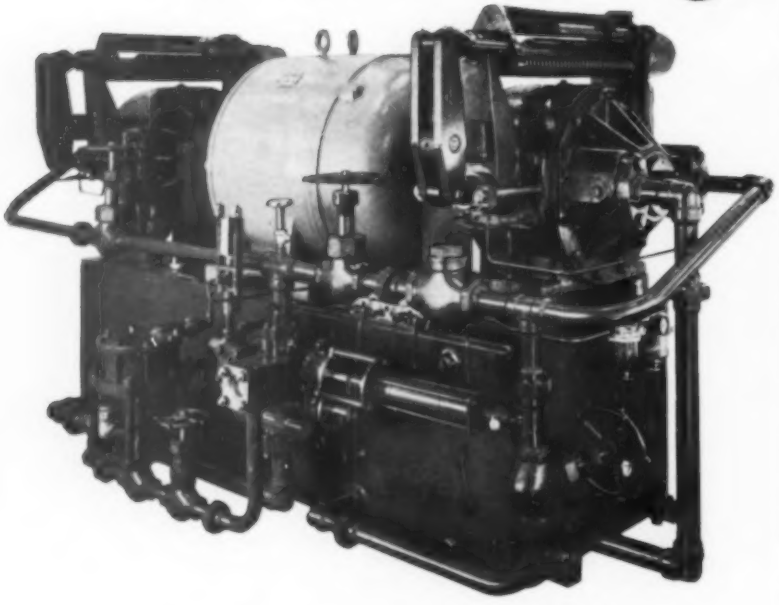
AIR & OIL CYLINDERS

Series A2 cylinders are rated at 250 psi air and up to 2400 psi hydraulic. Available in 11 bore sizes from 1½" through 14" with 25 mounting styles, and a wide range of piston rod diameters. (10C)—*S-P Mfg. Corp., Cleveland.*

Circle **427** on Reader Service Card

▼▼▼

$16,000 worth of *Quality*



This special 120 horsepower pumping unit with its integral valves and controls provides 88 GPM of oil and remotely adjustable pressures to 2500 psi to serve an intensifier in a hydrostatic testing system.

It was purchased on the basis of its LOW PRICE for high quality and guaranteed continuous performance.

On your next hydraulic application be economical—
Buy Quality By Lassman.

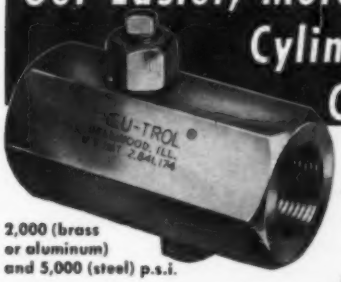
Two year guarantee on equipment of our manufacture.

BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA

Circle **100** on Reader Service Card

Circle **17** on Reader Service Card

Get Easier, More Accurate Cylinder Speed Control

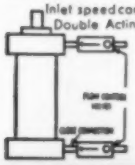


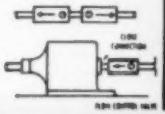
with **Pneu-Trol®** VALVES IN AIR OR HYDRAULIC USE

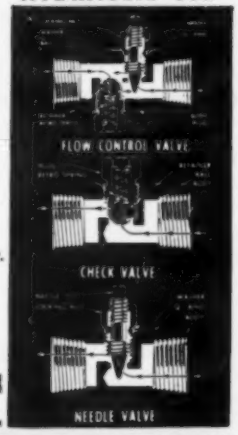
2,000 (brass or aluminum) and 5,000 (steel) p.s.i.

Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check Valve and Needle Valve incorporate single function features of Flow Control Valve. All valves available in 5 female pipe sizes — 1/8" to 3/4". Valve bodies are made from brass, aluminum, steel or stainless steel. Attractive Prices — Immediate Delivery.

Write for Illustrated Circular and Price List.



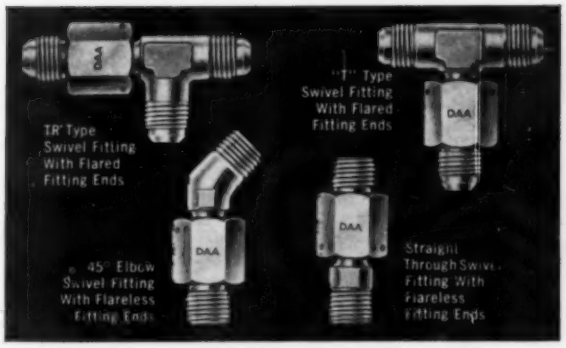




AUTOMATION AUTO-PONENTS INC COMPONENTS

2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

SELF ALIGNING SWIVEL FITTINGS FOR ANY ANGLE


"TR" Type Swivel Fitting With Flared Fitting Ends
"T" Type Swivel Fitting With Flared Fitting Ends
DAA
45° Elbow Swivel Fitting With Flareless Fitting Ends
Straight Through Swivel Fitting With Flareless Fitting Ends

Designed by DUMONT ENGINEERING to eliminate stress loads in tubing arising from operation, installation, vibration and other functional characteristics and to maintain a comparatively low torque rating, this small lightweight unit offers an ideal solution for many rotating or oscillating fluid line problems; suitable for operating pressures up to 5,000 PSI.

One of the most outstanding features of this unit is its automatic compensation for misalignment of up to 14° in addition to a 360° rotation. This self-aligning swivel is available with several different configurations to assure its flexibility and usefulness: straight-through, 45° angle, right angle, tee, cross or any angle.

With the characteristics of almost universal application this unit is suitable for nearly all types of liquids and gases. And every unit undergoes rigid inspections for quality control to insure its function and reliability.

Many other designs, sizes and fitting ends are available. For complete information and specifications write or phone:

PATENT APPLIED FOR

DUMONT ENGINEERING

DEPARTMENT H-2, 1401 FREEMAN, LONG BEACH, CALIFORNIA
PHONE: SPRUCE 5-1131 • GENEVA 3-4931

Circle **47** on Reader Service Card

When it's a Question of

"O" RINGS in any material or special compound for every service condition required.

PACKINGS to your specifications in leather, synthetics, asbestos, teflon, etc.

Also gaskets and washers in over 200 materials . . .

Look for the Answer at Auburn . . .

Send us your specifications or blueprints. You'll receive prompt quotations and recommendations without obligation

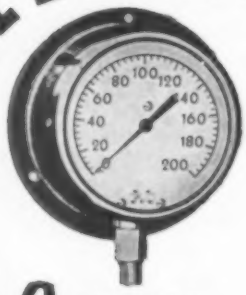
THE AUBURN MANUFACTURING CO.
308 Stack St., Middletown, Conn.

New York, N. Y.; Rochester, N. Y.; Detroit, Mich.; Chicago, Ill.; Minneapolis, Minn.; Pittsburgh, Pa.; Cincinnati, Ohio; Ridgewood, N. J.; Atlanta, Ga.; Memphis, Tenn.; St. Louis, Mo.; Washington, D. C.

Circle **14** on Reader Service Card

Circle 109 on Reader Service Card

MARSHALLTOWN



Gauges

The right gauge for your specific needs

A complete line of gauges in stock available for early delivery. Gauges from 10-inches water pressure to 30,000 P.S.I. to meet your specifications on any equipment.

- Pressure
- Vacuum
- Compound
- Altitude
- Combination
- Diaphragm
- Hydraulic
- Special Purpose
- Dial Thermometer (Vapor Tension or Bi-Metal)

Let Marshalltown answer your gauge problems . . . write for information and prices.

MARSHALLTOWN MANUFACTURING, Inc.
A Subsidiary of The Electric Autolite Company
MARSHALLTOWN, IOWA

CHECK BM VALVES

Specify the very best!

ULTRA PRECISION #750 SERIES
Very low back pressure. Disc sealing on "O" ring seat—3,000 PSI service. 1 PSI crack pressure. Leakproof.

ONE PIECE NIPPLE #1500 SERIES
Disc sealing on "O" ring seat. Excellent flow. —2 PSI crack. ¼, ⅜, ½ MPT. Leakproof.

ONE PIECE BODY #900 SERIES
Disc type—"O" ring sealing. 2 - 6 PSI crack pressure. ¼, ⅜, ½ M.P.T. Also —4, —6, —8 AND 10050. High pressure—leakproof.

SPECIALS
CUSTOM DESIGNED AND BUILT CHECK VALVES FOR HUNDREDS OF INDUSTRIES—QUANTITY PERMITTING

BODNAR & McDERMOTT MFG. CO. INC.
23 BEECHWOOD AVE., MT. VERNON, N.Y.

Circle 26 on Reader Service Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Baker named vice-president of Vickers

Baker

Election of David H. Baker as a vice president of Vickers Inc., Div. of Sperry Rand Corp. and a general manager of its International Div. has been announced. Baker, who has been president of Capital Airlines since 1957, succeeds R. E. Esch who has retired. Baker entered the field of civil aviation four years ago following retirement as a major general from the U. S. Air Force.

Curtis advanced to sales manager at Tomkins-Johnson

Curtis

The advancement of Robert L. Curtis to the position of sales manager of all products has been announced by the Tomkins-Johnson Co., Jackson, Mich. Curtis joined the engineering department at T-J in 1950; was later transferred to sales where he has had constant contact with field sales representatives and with engineering and manufacturing personnel.

Resistoflex appoints works manager

Richard T. Dale has been appointed works manager of Resistoflex Corp., Roseland, N. J. Dale joined the company eleven years ago and was most recently assistant to the executive vice president.

Kinkaide joins Vogt

Edwin L. Kinkaide has joined the Valve and Fitting Sales Div. of the New York office of the Henry Vogt Machine Co., Louisville. He was formerly with the Ohio Injector Co.

Vandermeulen

Kinkaide

New OTC district representative

Owatonna Tool Co., Owatonna, Minnesota, has appointed Richard Vandermeulen as district representative for the Tools & Equipment Div. for Iowa. Vandermeulen has considerable experience in industrial sales and merchandising. He has been with Herman M. Brown Co., Sieg-Des Moines Co., and Bendix Corp.

New distributors

Hydro-Line Mfg., Co., Rockford, Ill., has appointed *Lax Industrial Products*, Cleveland, as northeastern Ohio distributor, with offices in Cleveland, Warren, Youngstown, and Marion. *Sturgis Equipment Co.*, St. Louis, and Kansas City, will represent Hydro-Line in Missouri, Kansas, Nebraska, and southern Illinois.

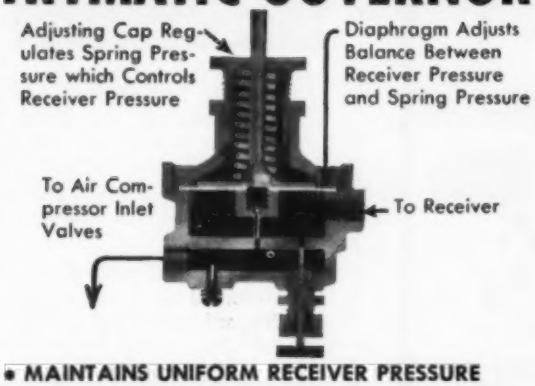
F & W Ursem Co., Cleveland, has been appointed exclusive stocking distributor in Cleveland and northern Ohio for the Lenz Co., Dayton, Ohio.

Continued on page 174

Circle **164** on Reader Service Card

NEW FOR AIR COMPRESSORS

TRYMATIC GOVERNOR


Adjusting Cap Regulates Spring Pressure which Controls Receiver Pressure
Diaphragm Adjusts Balance Between Receiver Pressure and Spring Pressure
To Air Compressor Inlet Valves
To Receiver

- **MAINTAINS UNIFORM RECEIVER PRESSURE**
- **BOOSTS COMPRESSOR OUTPUT UP TO 10%**
- **CUTS OPERATING AND MAINTENANCE COSTS**
- **FIELD TESTED • FITS ALL COMPRESSORS WITH UNLOADING INLET VALVES**

With the Trymatic Governor, air compressors can deliver uniform receiver pressure (within one pound of any given setting) at all times. Volumetric efficiency can increase by as much as 10%. It will cut operating and maintenance costs. Has only one self-actuating moving part and requires no maintenance! Write for Bulletin , Dept. HP.

TRYMAC, Inc.
16 WEST 5th ST.
ERIE, PA.

SYNFLEX *Pressure Hose*

Improved hydraulic hose incorporating precision-drawn nylon inner tube, nonmetallic reinforcing braid, abrasion-resistant extruded cover. Electrical non-conductor.

■ **Synflex Pressure Hose** is a new concept in high pressure hose for multi-purpose applications. Combines strength with light weight . . . no metal to fatigue . . . low cost. Use with water, fuels, oils, gases, solvents, refrigerants, conventional and non-flammable hydraulic fluids. Available with reusable couplings in a range of sizes from 3/16 thru 3/4 ID and larger. A-1619A

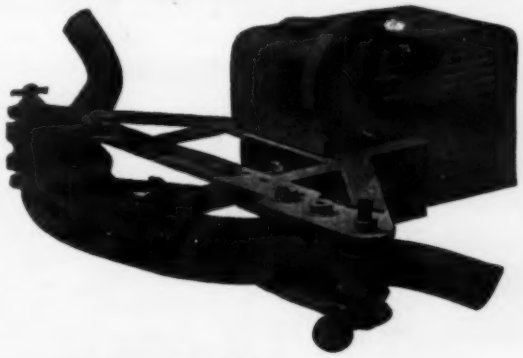
SYNFLEX
Products Div.
Samuel Moore & Co.
Mantua, Ohio

Circle **116** on Reader Service Card

STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Mark IV—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1—100 R.P.M. reversible). Overall efficiency 90%—95%.
Mark V—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1—75 R.P.M. reversible). Overall efficiency 90%—95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, cement mixers, drills, and most mechanical handling applications.



4" HYDRAULIC BENDER

Standard equipment includes 2"—4" formers for steam and gas pipes. The machine can be supplied either **Hand Operated** or **Motorised** and accessories are available for ⅜"—1½" steam and gas pipes, flat bar bending up to 7" x ½" section and electrical conduits up to 3".

A complete range of Hydraulic Pipe and Tube Benders ¼" to 18" dia. Pipes is available.

CHAMBERLAIN INDUSTRIES LTD.

Staffa Works, Argall Ave., Leyton, London, E.10, England.
Leytonstone 3678
(MEMBER OF THE CHAMBERLAIN GROUP OF COMPANIES)

American Distributors
Double A Products Company, Manchester, Michigan
Canadian Distributors
Affiliated Engineering Equipment Limited, 630, Cote de Liesse, Montreal

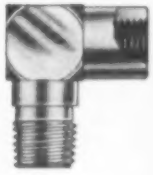
Circle **31** on Reader Service Card

Circle **99** on Reader Service Card

TUBE FITTINGS

L&L 37° flared tube fittings (to SAE & JIC standards) have heat-treated tube ends, and large wrench flats. The most complete line anywhere. All L&L fittings are made of plated steel.

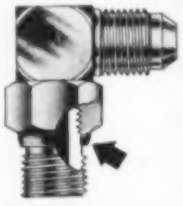
PIPE FITTINGS



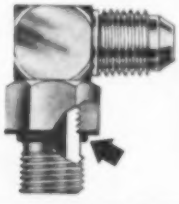
L&L dryseal fittings have annealed threads. Thick walls permit tapping for gauges. JIC.

METAL SEAL

L&L 'CN' fittings *seal*, with any fluid, temperature, pressure, or port metal. Will fit SAE port.



STRAIGHT THREAD TUBE FITTINGS



O-RING SEAL

L&L makes a complete line of standard SAE O-ring seal fittings. JIC.

"SPECIALISTS IN HYDRAULIC FITTINGS"

L and L Manufacturing Company

21590 Hoover Road • Warren, Michigan

DISTRIBUTORS IN PRINCIPAL CITIES

POST SCRIPTS OF INDUSTRY

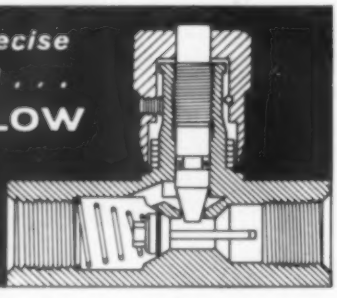
Henderson Engineering Co., Inc., Chicago, handles the pressure-loaded gear pumps of Wooster Div., Borg-Warner Corp., and the axial-piston pumps and fluid motors of Bicontinental Engineering.

Wainbee Tools Ltd. of Toronto and Montreal have been appointed by Clippard Instrument Laboratory Inc., of Cincinnati to distribute the Clippard Pneumatic Line in Canada. *Oyl-Air Equipment Co.*, Columbus, Ohio, has been appointed a stocking distributor for the Clippard Miniature Line in the central Ohio area.

The Cummins-Wagner Co., Baltimore, has been appointed to represent the Fluid Control Div., of Zurn Industries, Inc., Cummins-Wagner will call on contracting and engineering companies in the Baltimore region regarding strainers and accumulators.

For more precise Flow Control . . .

COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- Simple reading, recording, setting and adjusting
- Safe — adjustable under pressure
- Setting can be locked to hold adjustment
- Extremely sensitive — provides high flow and minimum pressure drop

- For oil, gas, vacuum, water and other fluids
- Pressures: Brass to 2000 psi Steel to 5000 psi
- Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads

Write for detailed literature

THE MANATROL Corp.
2372 W. 7th St. • Cleveland 13, O. • CH 1-0575

Circle **179** on Reader Service Card

your guide to the gear pump for your application

Searching for a gear pump with top volumetric efficiency?

• Eastern 1200 series — up to 1.6 gpm — pressures to 800 psi • Eastern 100 series — up to 5 gpm. — pressures up to 1500 psi • Eastern 700 series — up to 9.8 gpm — pressures up to 1500 psi. Save hours of searching your way through the gear pump maze — send for catalog 810 now!

Other Eastern products:

- hydraulic motors
- positive displacement pumps
- centrifugal pumps
- aircraft pumps

EASTERN INDUSTRIES, INC.

Hamden, Connecticut

Circle **51** on Reader Service Card

VICKERS INC., DIV. OF SPERRY RAND CORP. . . . A change in address for Houston facilities: Vickers Inc., 3101 Sage Rd., Houston 27, Tex.

OILGEAR CO. . . . Florian L. Assman is the new superintendent. He was named asst. superintendent in 1959; started with the company in 1942.

HUMMEL TECHNICAL PRODUCTS INC. . . . Mr. R. H. Dougherty has been appointed sales manager of Hummel's Technical Division.

KEARFOTT DIV., GENERAL PRECISION INC. . . . R. F. Ward and J. B. Heimann have been elected group vice-presidents; T. J. Thomas to vice-president.

YOUNG RADIATOR CO. . . . President and founder Fred M. Young was cited for outstanding accomplishment in his field at the 13th Annual Wisconsin Engineer's Day celebration.

TAYLOR TECHNICAL PRODUCTS . . . A change in address: 333 Freeport Road, Pittsburgh 15. Phone STerling 1-6300.

ALKON PRODUCTS CORP. . . . New factory branch offices in Detroit and Cleveland.

LINCOLN SUPPLY CO. . . . Two regional sales managers for New England have been appointed: M. Bieler in the eastern region; W. E. Norton in the western.

PARKER-HANNIFIN CORP. . . . D. R. Morse has been appointed sales engineer on components for mobile equipment. He will have assigned accounts in Ohio and Indiana.

Continued on page 177

new edition / free retaining ring engineering manual

shows how Ramco's tOtal 2 solves your toughest problems!

SINGLE TURN RINGS • MULTI-TURN RINGS • SELF-LOCKING RINGS

It takes two types of rings to answer *all* retaining ring needs. That's why Ramco's tOtal 2—Spirolox and Circolox — provide the *superior solution* to your retaining ring problems. Your free Engineering Manual brings you the complete story — write for it now!

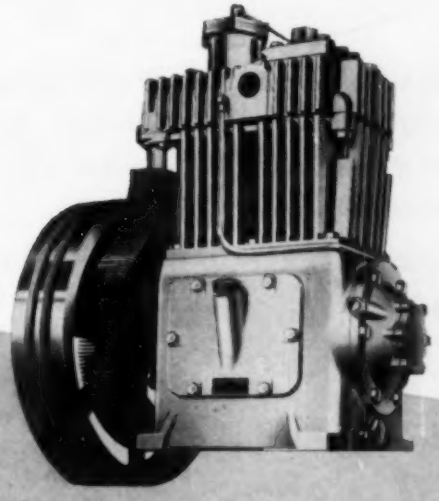
RAMSEY CORPORATION *a subsidiary of* ***Thompson Ramo Wooldridge Inc.***
Box 513, Dept. T, St. Louis 66, Missouri 168

Circle **137** on Reader Service Card

1 more good reason to think about Quincy

CUSHIONED STEEL VALVES assure extremely quiet operation for QUINCY COMPRESSORS. Each valve and seat is a separate assembly that can be removed for inspection without disturbing the other valves.

Designed by engineers who have pioneered air compressor advances for 40 years, each QUINCY is built to provide maximum service efficiency and long life. Cushioned steel valves are only 1 reason for QUINCY'S outstanding performance. Lynite connecting rods, automotive type pistons, Safe-Q-Lube pressure lubrication and Loadless Starting all contribute their functions and quality to the overall performance of QUINCY COMPRESSORS. The point is simply that you can count on a Quincy — for *years*. CHECK THE "Q-LINE" NOW — a complete range of industrial models for all applications.



Quincy COMPRESSORS

QUINCY COMPRESSOR CO., Quincy, Illinois
Makers of the World's Finest Air Compressors

Circle **135** on Reader Service Card

HALOGEN

PRECISION
TEFLON*
"U" Cups
FOR
LOW FRICTION-----
---HIGH TEMPERATURE
in any hydraulic fluid

Style 4505 "U" cups are accurately machined of virgin TEFLON to a special design developed by HALOGEN. 246 standard sizes are available without tooling charges.

Also available:
HALOGEN
"V"
RINGS
two types available for packed cylinders and other applications.

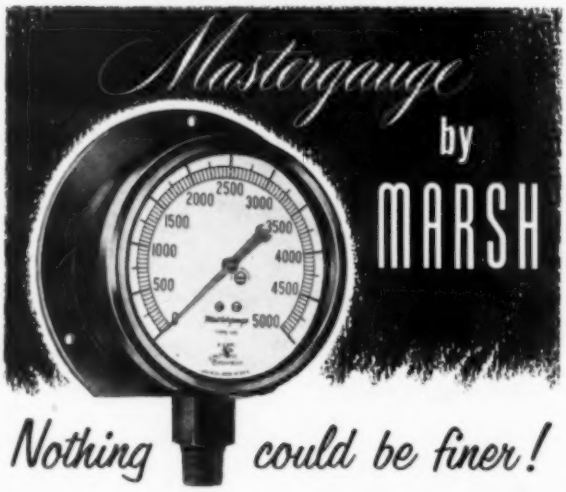
Write for literature . . . our new 12 page brochure on "U" cups is yours for the asking.

HALOGEN
INSULATOR & SEAL CORP.
9960 Pacific Ave. • Franklin Park, Ill.
"Engineers and manufacturers—TEFLON* Products"
*DuPont T.M.

Circle 74 on Reader Service Card

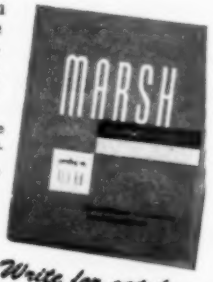
Circle 108 on Reader Service Card

Mastergauge by MARSH



Nothing could be finer!

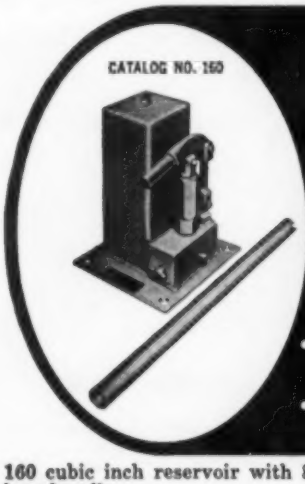
Mastergauge alone brings you "Conoweld" leakproof, one-piece tube and socket; sturdier Marsh-alloy case; precision mastergauge movement; stainless tube and socket when required.
Mastergauge is standard bearer for the broad line of Marsh Gauges for every service.



In stock at your nearest Supply House
MARSH INSTRUMENT COMPANY
Division of Colorado Oil and Gas Corporation • Dept. 19, Skokie, Ill., Marsh Instrument & Valve Co. (Canada) Ltd., 8607 103rd St., Edmonton, Alberta • Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas • Eastern Seaboard Warehouse: Marsh Instrument Company, 1209 Anderson Ave., Fort Lee, N. J.

Write for catalog

CATALOG NO. 160



Hand Hydraulic Pumps

- Single and Double Designs to 20,000 psi
- With or Without Reservoir

160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WM. S. PINE, INC.

hydraulic hand pumps for 1001 uses
1635 East 22nd St., Los Angeles 11, Calif.

Circle 131 on Reader Service Card

POST SCRIPTS OF INDUSTRY

WARD HYDRONICS INC. . . . E. P. Jensen has been appointed manager of manufacturing. He has been with the firm for four years.

GATES RUBBER CO. . . . V. E. Lehr has been transferred to Buffalo, N. Y.; R. C. Dalrymple has joined the firm as an Industrial Div. field engineer; K. G. Peterson has been appointed district sales coordinator for the Omaha sales district; and W. E. Johnson has joined as a field engineer in San Francisco.

MIDWESTERN INSTRUMENTS INC. . . . H. E. Felix has been appointed vice president and director of engineering. He joins the firm after twenty-one years of design engineering with Douglas Aircraft.

PLASTIC & RUBBER PRODUCTS CO. . . . J. Hoefle will be responsible for supervision and training of all Los Angeles salesmen. He has been associated with the rubber industry for twenty years.

WEATHERHEAD CO. . . . Two new appointments: S. C. Howell to general sales manager, general products, and R. R. Prothero as western sales manager for aviation and missile products.

MECHANICAL POWER TRANSMISSION DIV., ZURN INDUSTRIES INC. . . . C. M. Gipperich, Jr., has been named sales engineer for eastern and southeastern Kentucky and southern Indiana.

HASKEL ENGINEERING & SUPPLY . . . A new office in Denver: 216 Clayton St., Cherry Creek, Denver 6. Dick Marsh has been added to the firm's Seattle sales staff.

PARKER-HANNIFIN CORP. . . . R. A. Lux has been appointed sales engineer in New England; F. D. Zikas is now a sales engineer for mobile equipment components in the Illinois territory; R. G. Miller has been appointed application engineer for the Parker Hydraulics Div.; and J. P. Mockler is New England regional manager with headquarters in Wellesley Hills, Mass. A. W. Lindstrom has been made vice president of the International Div.

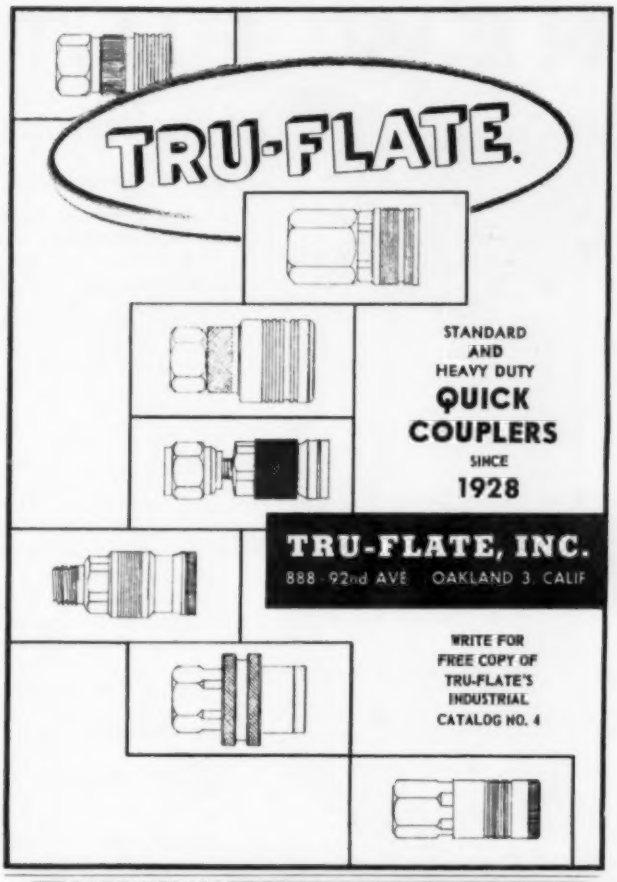
CHAMBERLAIN INDUSTRIES LTD. (London) . . . Appointment of two directors to the Board: D. W. Gray A.M.I. Mech.E to works director, and R. R. Watkins M.S.M.A. to sales director.

ROBBINS AVIATION INC. . . . A new facility for manufacture of gas purification/dehydration equipment and valves at 3817 South Santa Fe Ave., Los Angeles.

BARKER INSTRUMENT & MACHINE CO. INC. . . . E. L. Holbrook is now affiliated with the firm. He was formerly with Westinghouse Air Brake Co.

DENISON ENGINEERING DIV. AMERICAN BRAKE SHOE CO. . . . J. P. Sharp has been named western regional manager in Hawthorne, Calif. J. W. Stertzer is now midwest regional product manager in Chicago. Kenneth C. Harris has been appointed manager of marketing research. L. M. Krebs has been appointed manager of the Michigan district with headquarters at Troy. ▼▼▼

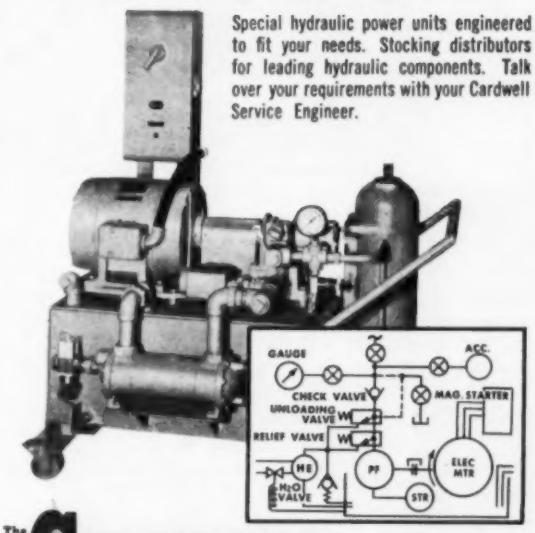
Circle **163** on Reader Service Card


TRU-FLATE.
STANDARD AND HEAVY DUTY
QUICK COUPLERS
SINCE 1928
TRU-FLATE, INC.
888 - 92nd AVE. OAKLAND 3, CALIF.
WRITE FOR FREE COPY OF TRU-FLATE'S INDUSTRIAL CATALOG NO. 4

CARDWELL'S

Custom Engineering in Industrial Hydraulics

Special hydraulic power units engineered to fit your needs. Stocking distributors for leading hydraulic components. Talk over your requirements with your Cardwell Service Engineer.



The CARDWELL MACHINE COMPANY
RICHMOND, VIRGINIA

Circle **29** on Reader Service Card

Circle **71** on Reader Service Card

NEW FILTER

with

FILTER CONDITION INDICATOR*

eliminates need for periodic service

A quick glance at the pressure gage on this new hydraulic line filter tells you when its element needs cleaning or replacement . . . warns of impending pressure build-up *before* the built-in by-pass valve can open and allow circulation of unfiltered fluid . . . makes unnecessary the costly and wasteful procedure of inspecting or changing elements at periodic intervals.

It's a big half-gallon filter, with choice of interchangeable monel wire cloth or phenol treated paper elements. Inlet and outlet ports are full 1¼" NPTF. Pressure drop at flow rate of 60 gpm is only 5 psi when using the 200-square-inch, 100-mesh, wire cloth element.

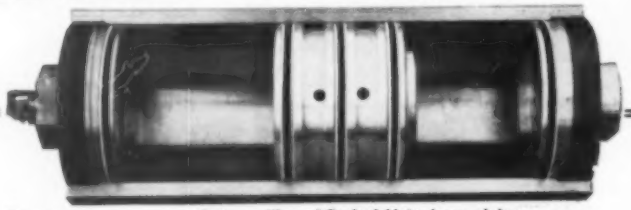
Filter may be installed in either the suction line (between tank and pump) or the return line (between control valve and tank), and the element is easily accessible.

***Amazing fact:** *The price of this new filter is even lower than many filters without this outstanding feature.*

GRESEN
MANUFACTURING CO.
405 - 36th AVENUE N.E., MINNEAPOLIS 18, MINN.

for Reliability—Quality—Delivery

HALE **Piston Type ACCUMULATORS**



Cutaway View of Typical Hale Accumulator

for:
- Auxiliary Power
- Leakage Compensator
- Surge Dampener
- Emergency Power

featuring:
- Self-Balancing Piston
- Triple "O" Ring Seal
- Auto-Relieving Piston

Send Today! For new, supplemental illustrated Bulletin No. 387.

The HALE Piston Accumulators feature a unique piston design which assures long seal life and no air or oil leakage. The free piston contains three "O" ring seals, all of which are active members. Any air or oil trapped between two seals is automatically discharged to its respective chamber during each piston stroke.
The end caps, accurately machined to receive the piston for dashpot action, use the same "O" ring seals as the piston, thus requiring only one seal size as spare parts.

Write to FLUID POWER DIVISION

HALE FIRE PUMP COMPANY
CONSHOHOCKEN, PA.

Circle **72** on Reader Service Card

MARKET PLACE

When replying to a box number in the Market Place, address your letter to Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

MANUFACTURING LICENSE

Substantial and expanding British company engaged in the manufacture of metal and synthetic rubber products for the hydraulic engineering industry seeks licensing agreements with correspondingly sound American concern for the manufacture of similar products for subsequent sale in European and Commonwealth markets. Write Box 9461, HYDRAULICS & PNEUMATICS.

HYDRAULICS & PNEUMATIC SALES ENGINEER

We are seeking a man who is an expert in the application of industrial hydraulic and pneumatic equipment. This man has probably gained his experience as a designer of special purpose or production machinery. A knowledge of electrical control circuits is desirable. An engineering degree or equivalent experience is required, although no previous sales experience is necessary.

We will train this man to become a sales engineer for fluid power components, his territory to be within the Metropolitan New York area. He may choose compensation from either salary or commission plans.

This is an unusual opportunity for the qualified man to enter this interesting and lucrative field of sales engineering. Please send resumé, in confidence, to: M. H. Lipton, The Airoyal Company, 1990 Springfield Avenue, Maplewood, New Jersey.

SALES MANAGER & ENGINEER WANTED

For hydraulic division of Los Angeles distributor representing top exclusive lines. Proven sales experience and thorough knowledge of hydraulic application and circuitry essential. Salary open, plus profit sharing from existing profitable operations, plus insurance and retirement benefits. Permanent position with established, 30 year old firm. Replies confidential. Submit 10 year resume to:

Paul Fornaciari
Fornaciari Company
5350 E. Washington Blvd.
Los Angeles 22, California

Continued on page 180

Circle **120** on Reader Service Card

SENSATIONAL, HIGH PERFORMANCE RECYCLING POPPET VALVE

NOVI-MATIC'S RECYCLING POPPET VALVE:

Automatically and completely eliminates static air pressure from pilot chamber of bleeder-type air-operated valves. Pressing of plunger opens poppet at bottom of valve. Poppet remains unseated until all static air is released and then reseats while plunger remains depressed.

Four way valve can be actuated in opposite direction even though poppet valve plunger is still depressed.

The Novi-Matic recycling poppet valve is the only poppet valve of its type with guaranteed superior performance and reliability.

Novi-Matic's recycling poppet valves, in conjunction with Novi-Matic's 3-way and 4-way valves, have proven themselves in a multitude of operations such as the automation of machines for drilling, milling, handling, packaging, assembling, bag making, embossing, wrapping, sizing, box making, bag filling, sealing, counting, tagging, bottle filling, marking, stamping, weighing, and many others.

Perhaps our valves could help your particular industry. Why not try them?

Write about our other poppet, 3-way & 4-way valves.

Novi-Matic Valve Division
Novi Tool & Machine Co. Novi, Mich.

INFINITELY VARIABLE DELIVERY

The Savery Variable Delivery Pump gives FLEXIBLE control which is completely POSITIVE over a wide range for use on hydraulically controlled Machinery, Agricultural and Factory lifting gear, Oil Burner equipment and hydraulics for AUTOMATION

SAVERY PUMPS have a proven record of great reliability in the METERING of chemicals and are used by VIKING ENGINEERING CO., Salford, in their renowed equipment for the production of POLYURETHANE Foams. If you will send full particulars of the properties of any chemicals you wish to pump or meter our Research Department will give you a prompt opinion of the ability of our equipment to handle them.

Tests can be carried out on your own materials and a candid and confidential report given with the minimum delay.

Thomas Savery Pumps Ltd.,
Newcomen Works,
Bracebridge Street
Birmingham 6, England
Phone Aston Cross 1316/7

Savery
HYDRAULIC PUMPS

Circle **146** on Reader Service Card

Mr. Design Engineer:

we take the "ache" out of SEALING HEADACHES

Outstanding research, production and testing facilities, in addition to experienced personnel; account for AERO GASKET's stand-out reputation for solving extra-tough sealing problems in hydraulic and pneumatic systems. AERO GASKET has designed and built gaskets and seals for operation at temperatures as low as −300° and up to 1900°F . . . and for sealing any type of liquid or gas up to a pressure of 2500 psi.

AERO GASKET also designs and manufactures diaphragms, actuators, accumulators, and precision parts of metal and/or molded materials. SEND PRINTS AND DETAILS FOR PROMPT QUOTATIONS.

MAIL COUPON FOR DATA SHEETS

THE AERO GASKET CORPORATION
29 Hanover Street, Meriden, Conn.

☐ Please send me the Data Sheets describing Aero Gasket's seals and gaskets.

I am also interested in:
☐ Precision molded parts ☐ Precision metal parts
☐ Diaphragms and diaphragm assemblies

name _____
company _____
co. address _____
city _____ zone ____ state _____

THE AERO Gasket CORPORATION
Meriden, Connecticut

DIAPHRAGMS • ACTUATORS • ACCUMULATORS
METALLIC & NONMETALLIC GASKETS
CLAMPS OF ALL TYPES AND DESCRIPTIONS
MOLDED RUBBER PARTS • METAL STAMPINGS • METAL-TO-RUBBER BONDING

Circle **3** on Reader Service Card

PRECISELY RIGHT!

For every application, specify Palmetto® Packings—molded with precision to improve the quality of your products . . . designed to permit you economies which lower your costs.

PALMETTO U-RING—for many applications where cup or V-packings formerly were required. "Snaps" into one-piece piston . . . eliminates glands, backing plates . . . saves space, machining.

PALMETTO PYRAMID®—advanced form of V-packing. New Sealsaver® Adapters—better, lower in cost than phenolic—now multiply V-ring life.

PALMETTO D-W SEAL—latest Palmetto innovation. Compact rod seal provides integral rod wiper . . . installs in simple counter-bore . . . sharply reduces machining costs.

PALMETTO G-T® RING—unique resilient ring seals without extrusion in pressures as high as 10,000 psi . . . will not wedge into clearances or twist in place.

PALMETTO KUP—sturdy, molded form of traditional piston packing. Kups resist heat and synthetic fluids . . . hold their shape . . . cannot become dried or hard.

Let Palmetto supply a recommendation for your current project. Send drawings and operating conditions for a specific product suggestion, and—today—ask for the Palmetto OEM product description sheet.

PALMETTO PACKINGS

GREENE, TWEED & CO.

OUR 99TH YEAR

NORTH WALES, PA.

Circle 68 on Reader Service Card

MARKET PLACE

Continued from page 178

SALES ENGINEERS NORTHERN AND SOUTHERN CALIFORNIA

Our continued growth has created outstanding sales openings for technically trained engineers with proven sales background in hydraulic components and systems. Now in our 20th year as the West's largest hydraulic sales and engineering specialists. Our complete engineering and manufacturing facilities provide full sales backup in component application and in overall system capabilities including nuclear power, missile GSE, marine, and complex industrial applications. Top compensation including substantial salary and commission. Excellent Profit Sharing Plan and Insurance benefits. Financial assistance if relocation is required. Forward resumes in strict confidence to Donald A. Anderson. Local interviews will be arranged at NCIH meeting in Chicago in October.

THE RUCKER COMPANY
4700 SAN PABLO AVENUE
OAKLAND 8, CALIFORNIA

MANUFACTURER'S REPRESENTATIVES & DISTRIBUTORS WANTED

Nationally known Midwest manufacturer of accumulators, mobile and industrial cylinders, and piston pumps, converting from direct selling to exclusive manufacturer's agents, has openings in Atlanta, Baltimore, Cincinnati, Florida, New York City, Illinois, San Francisco, Seattle, Portland, Wisconsin, and Minnesota. Reply, giving sales qualifications in fluid power products, to Box 9161, HYDRAULICS & PNEUMATICS.

SALES MANAGER WANTED

Shell and tube heat exchangers. Graduate engineer, experienced. Direct sales and manufacturers representatives. National distribution hydraulic, processing, and internal combustion engine fields. Salary commensurate with experience and ability. Write Box 9561, HYDRAULICS & PNEUMATICS.

PUMP & MOTOR LINE WANTED

Wanted, for the States of Alabama, Mississippi, and Western Florida, a good line of hydraulic pumps and motors. We are an old established Manufacturers representative thoroughly familiar with Fluid Power for over ten years. Write Box 9361, HYDRAULICS & PNEUMATICS.

SALES ENGINEERS WANTED

Manufacturer of hydraulic components has openings in East Coast and Middle West territories for Sales Engineers with engineering degree or equivalent. Requires experience in sales and engineering, preferably in hydraulics. Will represent company at top engineering and purchasing level. Travel required. Age 27 to 37. Salaried. Write Box 9261, HYDRAULICS & PNEUMATICS.

Classified Advertising Rates: Twenty dollars for the first inch and fifteen dollars for each additional inch or fraction thereof.

MOOG SERVOCONTROLS, INC.

Our continued growth in both the industrial and military electro-hydraulics fields has created opportunities for:

PROTOTYPE ENGINEER—Specify electro-hydraulic servo components and direct prototyping operations preparatory to volume production. 5 or more years experience with servo mechanisms essential. Familiarity with electronics instrumentation and military specs necessary. Project experience desirable.

RELIABILITY ENGINEER—Evaluate basic design parameters, considering materials, tolerances, stress and statistical analysis. Physics, M.R. or E.E. degree and grad. work essential. 4 years background in reliability or electro-mechanical systems testing or design analysis. Key position conducting design evaluations and directing testing of intricate electro-hydraulic components.

PRODUCT AND MARKET DEVELOPMENT ENGINEER—Explore Moog's entry into totally new fields. Number 2 man in crucial area of product development, requiring strong technical background and market "curiosity". 4-6 years servo, hydraulics, controls or instrumentation experience. Must have "feel" for unusual applications of our electro-hydraulics know-how.

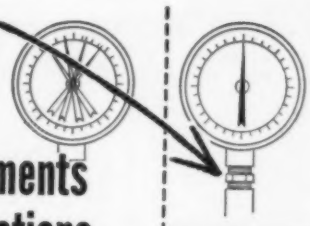
SERVO DESIGN ENGINEER. Senior-Technical responsibility for design and development of electro-hydraulic components. Work involves dynamic analysis, component specification, design mechanization, test evaluation, proposal preparation, and customer contact. Similar background essential.

These positions offer you unusual professional advancement in our engineering oriented Company, located in suburban Buffalo.

MOOG SERVOCONTROLS, INC., East Aurora, N.Y.

Circle **32** on Reader Service Card

NOW



protect instruments from line pulsations and surges on refrigeration and automotive systems...

CHEMIQUIP'S NEW RS SNUBBERS

Designed for automotive, refrigeration or air conditioning applications, Chemiquip's newest snubber assures steady, accurate pressure readings . . . smooths out pressure impulses and fluctuations . . . protects pressure-sensitive instruments. Snubber element fabricated of Type 316 porous stainless steel membrane; unaffected by suspended oils in freon-type refrigerants . . . does not clog or plug.

Available in brass or steel in 1/8" and 1/4" npt, male or female by 1/4", 1/4", 3/8" and 3/8" flared and compression tubing.

Write TODAY for detailed bulletin BW-741

CHEMIQUIP CO. **36 East 10th St., New York 3**
GRamercy 7-3772

OIL LEVEL GAUGES

- FLUSH-MOUNTING
- DIRECT READING
- HEAVY PATTERN
- EASILY INSTALLED

TYPE 550 AVAILABLE IN 4 STANDARD PRODUCTION SIZES WITH 4", 6", 8" AND 12" LONG SIGHT OPENINGS.

DESIGNED FOR USE ON HYDRAULIC AND LUBRICATING OIL RESERVOIRS AND OTHER LIQUID LEVEL APPLICATIONS.

MODELS AVAILABLE FOR:
- MINERAL OILS
- GLYCOL-WATER SOLUTIONS
- WATER-OIL EMULSIONS
- PHOSPHATE ESTERS
- LOW PRESSURE SERVICE

FOR COMPLETE INFORMATION WRITE
FEDERAL BRASS MFG. COMPANY
ELMIRA 2, N.Y.

Circle **53** on Reader Service Card

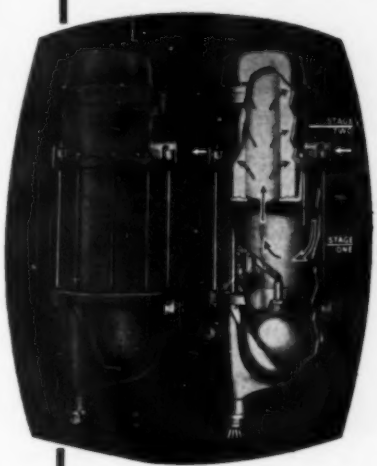
Get clean, dry oil-free compressed air!

Use this dependable

WILKERSON

heavy-duty, float-draining

FILTER



Your paint sprayers, air cleaners, agitating devices, instruments and air tools are not delivering full profit potential if contaminants destroy efficiency and long life.

The Wilkerson ARID-AIR Filter

★ Individual moisture-separating and filtering chambers provide 2-stage action which extends the life of the low-cost cartridge 4 times.

★ *Automatically* discharges up to 500 gallons of moisture per hour.

★ Removes particles as small as 3 microns in size.

★ Available from 1/2" to 2" P. T. up to 425 CFM with only 1.10 to 3.50 pressure drop. Maximum pressure 250 PSI.

WRITE TODAY

for complete ARID-AIR information contained in circular 1027 and name of your nearest Wilkerson distributor.

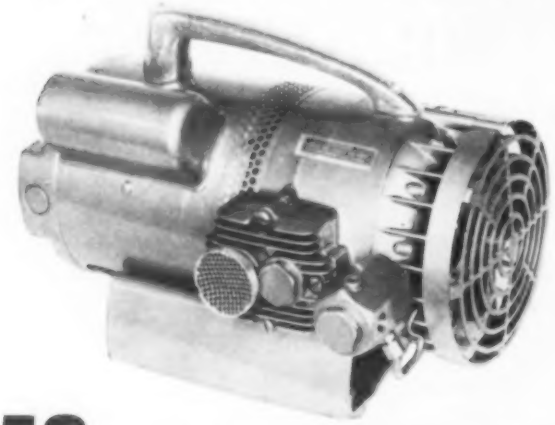
WILKERSON CORPORATION

Dedicated to keeping the NEW in pNEUmatics

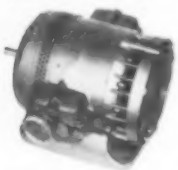
1643 West Mansfield, Englewood, Colorado

Circle **177** on Reader Service Card

DESIGNERS ARE LEANING TO B&G *Oil-less* COMPRESSED AIR TO DO MORE JOBS BETTER



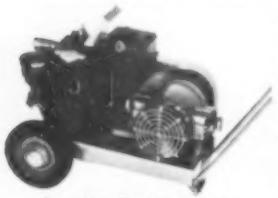
58 MODELS—1/12 to 3/4 HP—Pressures: to 190 psi. Vacuum: 27.5"—Air displacement: to 6.57 CFM.



Bare compressor (less motor)

10 gallon Air Tank Motor Compressor Outfits

30 gallon Air Tank Motor Compressor Outfits



Gasoline Engine Driven Compressor Outfits

Use of compressed air is rapidly increasing because of its many exclusive advantages as motive power, for process agitation and for energizing intricate mechanical movements. B&G Air Compressors fit ideally into this picture because they are *oil-less!*

There is no chance of oil-spoiled work—*not a drop of oil* can be found in this compact, lightweight compressor. Motor and compressor are permanently grease-packed...carbon-graphite piston rings and skirts operate for years without injury to the cylinder walls. Since the cylinders are not oil lubricated, air is always oil-free—no oil separator needed—no costly lubrication maintenance.

B&G oil-less Compressors are velvet-smooth! Modern design, large bores, short stroke, horizontally opposed pistons provide better balance and vibrationless operation. B&G Compressors are available in a complete line of portable, tank mounted, tankless and gasoline engine driven models.

Send for Catalog GO-259

Oil-less **AIR COMPRESSORS**

BELL & GOSSETT COMPANY

Dept. GU-66, Morton Grove, Illinois

Circle **21** on Reader Service Card

Circle **154** on Reader Service Card

Need Help with HIGH PRESSURE PROBLEMS?

3000 PSI to 15,000 PSI

Star HI-LO Two Speed Manual Hydraulic Pump operated by single lever.

Hydraulic Pumps, Cylinders and Rams—one or a hundred—rugged precision machined units designed, adapted or built to your drawings or performance specifications. *Star* quality is the reason Star units are integral in many high-performance machines.

Qualified Star Hydraulic Engineers are available to help you. Send us your pressure problems. We will present recommendations and a proposal based on your requirements.

Write for Bulletin 160.

STAR HYDRAULICS, INC.

2638 DAVISSON ST. • DEPT. C • RIVER GROVE, ILLINOIS

SINGLE PISTON HYDRAULIC PUMPS

SOLID AND CENTER-HOLE RAMS

200 TON REMOTE RAM and PUMP

WILEY BOOKS

WATER HAMMER IN HYDRAULICS AND WAVE SURGES IN ELECTRICITY

By the late LOUIS BERGERON, *Ecole Centrale des Arts et Manufactures.* A collective effort of leading authorities has resulted in this translation, which presents the classical, *graphical method* for solving highly complex problems of water hammer. The method is extended also to analysis of transient phenomena on power transmission lines, and to vibrations and shocks in mechanical systems. It is a simple approach, requiring no knowledge of higher mathematics. Many solutions of practical examples form a most valuable part of the book. *1961. 320 pages. $15.00*

FLUID POWER CONTROL

Edited by J. F. BLACKBURN, GERHARD REETHOF, *and* J. L. SHEARER, *all of M.I.T.* 1960. 710 *pages.* $17.50

Send now for your on-approval copies

JOHN WILEY & SONS, Inc.

440 Park Avenue South, New York 16, N. Y.

Circle **176** on Reader Service Card

ADVERTISERS' INDEX

September, 1961

A & A Mfg. Co., Inc. 22
Adel Products Div.
General Metals Corp. 45
Aero Gasket Corp. 179
Aeroquip Corp. 15
Air-Mite Devices, Inc. 166
Alemite Div.
Stewart-Warner Corp. 48
Almo Manifold & Tool Co. 18
American Bosch Arma Corp. 68
American-Standard Controls Div. 95
Anchor Coupling Co., Inc. 5
George Angus & Co. Ltd. 119
AquaMatic, Inc. 74
Auburn Mfg. Co. 171
Autoclave Engineers, Inc. 4
Automatic Switch Co. ..... Cover 3
Auto-Ponents, Inc. 171

Barksdale Valves 148, 149
Beckett-Harcum Co. 58
Bell & Gossett Co. 182
Bellows-Valvair, Div. IBEC 8
Bendix-Westinghouse Automotive
Air Brake Co. 77
Benton Harbor Engineering
Works, Inc. 70
Berry Hydraulics,
Div. Oliver Tyrone Corp. 169
Bodnar & McDermott Mfg. Co., Inc. 172
Bruning Co. 35

Cardair, Div. Marmon-Herrington
Co., Inc. 142
Cardwell Machine Co. 177
Century Hydraulics 152
Chamberlain Industries Ltd. 173
Chemiquip Co. 181
Circle Seal Products Co. 135
Clemco Aero Products, Inc. 122
Commercial Filters Corp. 78
Commercial Shearing &
Stamping Co. 93
Control Switch Div.,
Controls Co. of America 135
Crawford Fitting Co. 47
Cross Mfg. Co. 160

Dalton Foundries, Inc. 158
Darling Valve & Mfg. Co. 66
De Laval Steam Turbine Co. 64
Denison Eng. Div.,
American Brake Shoe Co. 97
Detroit Coil Co. 67
Diaphragm Industries, Inc. 98
Dow Corning Corp. 101
Dumont Engineering 171
E. I. du Pont de Nemours
& Co. (Inc.) 19
Dyna-Quip, Div. Stile-Craft
Manufacturers, Inc. 80

Eastern Industries, Inc. 151, 174
Ex-Cell-O Corp., Rotac Div. 51

Federal Brass Mfg. Co. 181
Flodar Corp. 96
Fluid Controls, Inc. 158
Fluid Dynamics, Inc. 139
Formrite Tube Co. 72
Fulflo Specialties Co., Inc. 14
Futurecraft Distribution Corp. ..137, 139

ROPER PUMPS

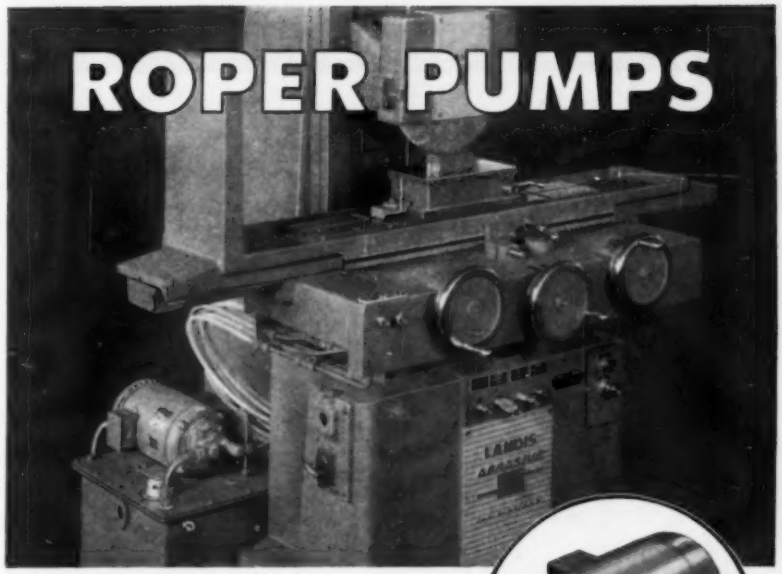


Photo courtesy Landis Tool Co.

supply hydraulic oil to surface grinder hydraulic system

• **CAPACITY: .3–55 GPM** • **PRESSURE TO 400 PSI**

The hydraulic system controlling the hydraulic table traverse and hydraulic crossfeed on this Landis 618 precision surface grinder is activated with a Roper Fig. 11TM748 pump and motor unit. The Series T hydraulic pump motor is the bell end of the ¾ hp, 1800 rpm electric motor. It delivers 2.8 gpm 150 SSU hydraulic oil at 200 psi. Landis Tool Co. has been using this Roper hydraulic pump motor on the 618 since introducing this hydraulic surface grinder in 1960. Many original equipment manufacturers requiring transfer, hydraulic or pressure feed work with clean liquids have found that Roper Series T pumps fit their specifications. There are 192 models of the Series T pump. Get full information about this efficient unit for your equipment.

PRECISION HANDLING OF HYDRAULIC WORK

- **PUMP GEARS** are steel, hobbed and shaved for balanced, quiet operation. Driven gear mounted on motor shaft eliminates couplings, reduces space.
- **BRONZE BEARING** in backplate assures proper alignment of driving and pumping elements.
- **MOTORS** for Series T units are open drip proof or totally enclosed types. Standard NEMA frame sizes are used throughout the series.

For information about your specific pump needs contact your nearest Roper dealer

Send for "How to Solve Pumping Problems" booklet

ROPER HYDRAULICS, INC.

Dependable pumps since 1857
COMMERCE, GEORGIA

Circle **143** on Reader Service Card

NEW NEW NEW NEW NEW NEW

NOW! 1½ TONS PER SQUARE INCH CONTINUOUS RATING

*Tested at 2½ tons per square inch

Pathon 3000 PSI HYDRAULIC CYLINDERS

The New Pathon Series 3H Hydraulic Cylinders are not an adaptation or modification of existing models, but specially designed 3000 P.S.I. Cylinders, continuous service. The 3H Series is available in a wide range of bore sizes and standard mounting types. Like all other Pathon Cylinders, the 3H Series features:

- Single screw thread head attaching method
- Increased strength and fatigue life
- Low Stress Concentration
- Compactness

Illustrated, Model 3H 33 incorporating spherical bearing at the pin connection.

FOR ADDITIONAL INFORMATION
WRITE—WIRE—PHONE TODAY

Pathon MANUFACTURING COMPANY
3823 PACIFIC AVE., CINCINNATI 12, OHIO

FLUID OPERATED AND CONTROL EQUIPMENT

Circle 129 on Reader Service Card

Gar Wood Industries, Inc., Hydraulic Div. 115
Garlock, Inc. 13, 131
Gast Mfg. Corp. 104
Glassco Instrument Co. 144
Goshen Rubber Co., Inc. 29
Greene, Tweed & Co. 180
Greenlee Tool Co. 36
Greer Hydraulics, Inc. 156
Gresen Mfg. Co. 178

Hale Fire Pump Co. 178
Hall & Hall Ltd. 79
Halogen Insulator & Seal Corp. 176
Hanna Engineering Works 1
Hannifin Co., a div. of Parker-Hannifin Corp. 46
Hansen Mfg. Co. ..... Cover 2
Haskel Seals Div., Haskel Engineering & Supply Co. 136
Haydon Switch, Inc. 137
Heise Bourdon Tube Co. 138
Helicoid Gage Div., American Chain & Cable Co., Inc. 62
Herion, Inc. 165
Hilliard Corp. 16
Houdaille Industries, Inc. 30
E. F. Houghton & Co. 54
Hunt Valve Co., Div. IBEC 21
Hydraulic Accessories Co. 168
Hydreco Div., New York Air Brake Co. 103
Hydronic Corp. 168

Imperial-Eastman Corp. 154, 155
Industrial Timer Corp. 167
International Packings Corp. 145

James Pond & Clark, Inc. 135
Jamesbury Corp. 73
Johns-Manville 141

Kearfott Div., General Precision, Inc. 146
Kebby Co. 150
Keelavite Hydraulics Ltd. 111
Kepner Products Co. 152

L & L Mfg. Co. 174
Benjamin Lassman & Son 170
Le Roi Div., Westinghouse Air Brake Co. 50
Lear-Romec Div., Lear, Inc. 75
Leiman Bros., Inc. 165
Lisle Corp. 167
Logansport Machine Co., Inc. 163
Lucas-Rotax Ltd. 42

M.C. Mfg. Co. 137
Manatrol Corp. 174
Marsh Instrument Co., Div. Colorado Oil & Gas Corp. 176
Marshalltown Mfg., Inc., Subs. Electric Autolite Co. 172
Marshalsea Bros. Ltd. 166
Marvel Engineering Co. 6, 7
Miller Fluid Power Div., Flick-Reedy Corp. 164
Minnesota Rubber Co. 2
Modernair Corp. 17
Moeller Mfg. Co., Industrial Div. 167
Monsanto Chemical Co., Organic Chemicals Div. 59
Samuel Moore & Company, Synflex Products Div. 173

National Acme Co. 117
National Seal Div., Federal-Mogul-Bower Bearings, Inc. 143
C. A. Norgren Co. 25
Novi Tool & Machine Co. 179
Numatics, Inc. 41

Oilgear Co. 9
Ortman-Miller Machine Co., Inc. 23
Owatonna Tool Co. 12

Page Belting Co. 44
Pall Corp. 135
Parker Fittings & Hose Div. Parker-Hannifin Corp. 60, 61, 157
Parker Seal Co. 37
Parker-Hannifin Corp. Hannifin Co. Div. 46
Parker Fittings & Hose Div. 60, 61, 157
Pathon Mfg. Co. 184
Perfecting Service Co. 32
Wm. S. Pine, Inc. 176
Plastic & Rubber Products Co. 185
Precision Rubber Products Corp. 112
Purolator Products, Inc. 110

Quincy Compressor Co. 175

Racine Hydraulics & Machinery, Inc. 106
Ramsey Corp. 175
Raybestos-Manhattan, Inc. 159
Republic Mfg. Co. 168
Republic Steel Corp. 99
Reuland Electric Co. 71
Rivett Lathe & Grinder, Inc. 49
Roper Hydraulics, Inc. 183
Ross Operating Valve Co. 11
Rucker Co. 76

Thomas Savery Pumps Ltd. 179
A. Schrader's Son, Div. Scovill Mfg. Co. 39
Sheffer Corp. 98
Shell Oil Co. 161
Skinner Electric Valve Div., Skinner Precision Industries, Inc. 33, 34
Snap-Tite, Inc. 43
Southwest Products Co. 162
Star Hydraulics, Inc. 182
Stewart-Warner Corp., Alemite Div. 48
Stile-Craft Manufacturers, Inc., Dyna-Quip Div. 63
Stratoflex, Inc. 63
Sun Oil Co. 65
Symetrics, Inc. 137
Synflex Products Div., Samuel Moore & Co. 173

Thomson Industries, Inc. 147
Tomkins-Johnson Co. 57
Towler Brothers (Patents) Ltd. 69
Ronald Trist & Co. Ltd. 102
Tru-Flate, Inc. 177
Trymac, Inc. 173

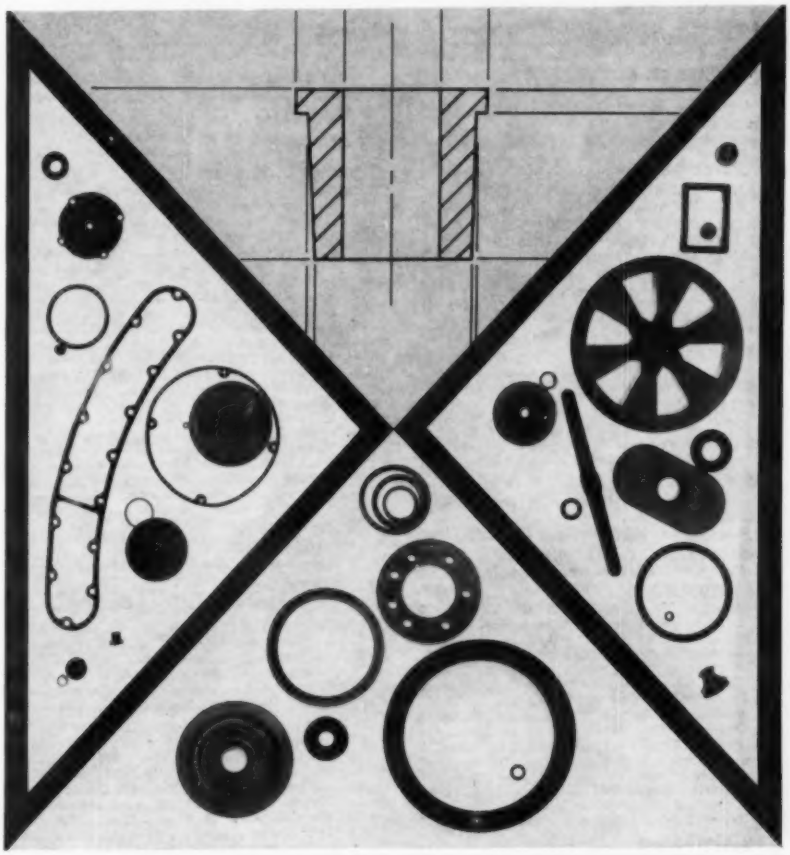
Universal Hydraulics, Div. Holan Corp. 38

Vickers, Inc., Div. Sperry Rand Corp., Machinery Hydraulics Div. 52, 53

Ward Hydronics, Inc. 150
Waterman Hydraulics Corp. 56
Watts Regulator Co. 55
Weatherhead Co. 26, 27
Webster Electric Co., Oil Hydraulics Div. 24
Westinghouse Air Brake Co. 153
Weston Hydraulics Ltd., Subs. Borg-Warner Corp. 129
E. B. Wiggins Oil Tool Co., Inc. 139
John Wiley & Sons, Inc. 182
Wilkerson Corp. 181
Wooster Div., Borg-Warner Corp. 31

PARCO PROBLEM PROBERS

?!?...ACCURATE CUSTOM MOLDING



!!! Why gamble on the quality and accuracy of the custom molded rubber parts in your product design? Turn to a custom molder with a record of successfully producing such parts to the most rigid specifications. Turn to Parco. ◯ For many years Parco has been one of the nation's major producers of accurate custom molded rubber components for aircraft, missiles and other military applications. The same high production standards, refined production techniques, quality controls, and experienced personnel are employed for all custom molded products. ◯ Furnish your own tooling for these parts, or let Parco tooling engineers develop the tooling from your blueprints and specifications. In either case, feel assured of dimensional accuracy, guaranteed quality and prompt delivery. Custom molded parts can be produced to meet any existing specification requirements with total assurance of required operational characteristics.

Send for your latest Parco Slide Rule

Plastic and Rubber Products Company
2100 Hyde Park Boulevard
Los Angeles 47, California

Plastic and Rubber Products Company
2100 Hyde Park Blvd. • Los Angeles 47, Calif.
Please send the Parco O-Ring Data Chart to:

NAME_____
COMPANY_____
BUSINESS ADDRESS_____
CITY_____
ZONE____ STATE_____

Circle **132** on Reader Service Card

Reader Service Index

Circle numbers on these post cards for more information ➧

Alphabetical index of advertisers is on pages 183-185.

Page No.		Circle No.
	ACCUMULATORS	
68	American Bosch Arma Corp.	8
156	Greer Hydraulics, Inc.	70
178	Hale Fire Pump Co.	72
	ACTUATORS, ROTARY	
51	Ex-Cello-O Corp.	52
30	Houdaille Industries, Inc.	84
	AIR COMPRESSORS	
182	Bell & Gossett Co.	21
50	Le Roi Div.	101
175	Quincy Compressor Co.	135
	AIR COMPRESSORS, AIRCRAFT	
137	M.C. Manufacturing Co.	107
	AIR FILTERS, REGULATORS, LUBRICATORS & ACCESSORIES	
158	Fluid Dynamics, Inc.	57
25	C. A. Norgren Co.	119
39	A. Schrader's Son	147
173	Trymac, Inc.	164
55	Watts Regulator Co.	169
181	Wilkerson Corp.	177
	AIR MOTORS	
104	Gast Mfg. Corp.	65
46	Hannifin Co.	76
	BEARINGS	
162	Southwest Products Co.	153
	BELLOWS	
22	A&A Mfg. Co., Inc.	1
	BOOTS	
22	A&A Mfg. Co., Inc.	1
	CHUCKS	
163	Logansport Machine Co., Inc.	105
	COUPLINGS, CRYOGENIC	
139	Futurecraft Distribution Corp.	61
	CYLINDERS	
166	Air-Mite Devices, Inc.	5
77	Bendix-Westinghouse Automotive Air Brake Co.	23
70	Benton Harbor Engineering Works, Inc.	24
160	Cross Manufacturing Co.	39
164	Miller Fluid Power Div.	111
17	Modernair Corp.	113
23	Ortman-Miller Machine Co.	122
184	Pathon Mfg. Co.	129
39	A. Schrader's Son	147
98	Sheffer Corp.	148
57	Tomkins-Johnson Co.	160
38	Universal Hydraulics	165
150	Ward Hydronics, Inc.	167
	DIAPHRAGMS	
98	Diaphragm Industries, Inc.	45
	ELECTRIC MOTORS	
71	Reuland Electric Co.	141
	FLAP ACTUATORS	
122	Clemco Aero Products, Inc.	34
	FLUID MOTORS	
173	Chamberlain Industries, Inc.	31
103	Hydreco Div.	88
75	Lear-Romec Div.	102
9	Oilgear Co.	—
106	Racine Hydraulics & Machinery, Inc.	136
27	Weatherhead Co.	171
	GAS COMPRESSORS	
142	Cardair	28
	HOSE, FITTINGS & ASSEMBLIES	
15	Aeroquip Corp.	4
48	Alemite Div.	6
5	Anchor Coupling Co., Inc.	10, 11
60, 61	Parker Fittings & Hose Div.	126
63	Stratoflex, Inc.	156
27	Weatherhead Co.	171
	HOSE-TO-TUBE ASSEMBLIES	
72	Formrite Tube Co.	58
	HYDRAULIC FILTERS & ACCESSORIES	
78	Commercial Filters Corp.	35
178	Gresen Mfg. Co.	71
16	Hilliard Corp.	83
6, 7	Marvel Engineering Co.	—
110	Purolator Products, Inc.	134
	HYDRAULIC FLUIDS	
101	Dow Corning Corp.	46
54	E. F. Houghton & Co.	85
59	Monsanto Chemical Co.	115
161	Shell Oil Co.	149
65	Sun Oil Co.	157
	JOINTS, ROTARY, SWIVEL	
171	Dumont Engineering Co.	47
32	Perfecting Service Co.	130
	MAGNETIC PLUGS, SEPARATORS & STRAINERS	
150	Kebby Co.	96
167	Lisle Corp.	104
	MANIFOLDS	
18	Almo Manifold & Tool Co.	7
	MATERIAL FOR PACKINGS, SEALS	
19	E. I. du Pont de Nemours & Co., (Inc.)	48
	PACKINGS & SEALS	
179	Aero Gasket Corp.	3
119	George Angus & Co. Ltd.	12
171	Auburn Mfg. Co.	14
66	Darling Valve & Mfg. Co.	41
13, 131	Garlock, Inc.	63, 64
29	Goshen Rubber Co., Inc.	67
180	Greene, Tweed & Co.	68
79	Hall & Hall Ltd.	73
176	Halogen Insulator & Seal Corp.	74
136	Haskel Seals Div.	78
54	E. F. Houghton & Co.	85
168	Hydraulic Accessories Co.	87
145	International Packings Corp.	92
141	Johns-Manville	94
2	Minnesota Rubber Co.	112
143	National Seal Div.	118
44	Page Belting Co.	124
37	Parker Seal Co.	128
185	Plastic & Rubber Products Co.	132
112	Precision Rubber Products Corp.	133
159	Raybestos-Manhattan, Inc.	138
102	Ronald Trist & Co. Ltd.	162
139	E. B. Wiggins Oil Tool Co., Inc.	175
	PIPE & TUBE BENDERS	
173	Chamberlain Industries Ltd.	31
	PLUGS	
167	Moeller Mfg. Co., Inc.	114
	POWER UNITS	
177	Cardwell Machine Co.	29
111	Keelavite Hydraulics Ltd.	97
170	Benjamin Lessman & Son	100
9	Oilgear Co.	—
52, 53	Vickers, Inc.	166
	PRESSURE GAGES	
95	American-Standard Controls Div.	9
144	Glasseo Instrument Co.	66
138	Heise Bourdon Tube Co., Inc.	80
62	Helicoid Gage Division	81
176	Marsh Instrument Co.	108
172	Marshalltown Mfg.	109
135	Pall Corp.	125
	PRESSURE SNUBBERS	
181	Chemiquip Co.	32
	PRESSURE SWITCHES	
95	American-Standard Controls Div.	9
144	Glasseo Instrument Co.	66
137	Haydon Switch, Inc.	79
135	Pall Corp.	125
	PUMPS	
45	Adel Products Div.	2
169	Berry Hydraulics	25
64	De Laval Steam Turbine Co.	42
151, 174	Eastern Industries, Inc.	50, 51
115	Gar Wood Industries, Inc.	62
36	Greenlee Tool Co.	69
103	Hydreco Div.	88
75	Lear-Romec Div.	102
42	Lucas-Rotax Ltd.	106
106	Racine Hydraulics & Machinery, Inc.	136
183	Roper Hydraulics, Inc.	143
179	Thomas Savery Pumps Ltd.	146
69	Towler Bros. (Patents) Ltd.	161
52, 53	Vickers, Inc.	166
27	Weatherhead Co.	171
24	Webster Electric Co.	172
	PUMPS, AIR	
165	Leiman Bros., Inc.	103
	PUMPS, HAND	
12	Owatonna Tool Co.	123
176	Wm. S. Pine, Inc.	131
182	Star Hydraulics, Inc.	154
	QUICK-CONNECT COUPLINGS	
Cover 2	Hansen Mfg. Co.	77
43	Snap-Tite, Inc.	151
80	Stile-Craft Manufacturers, Inc.	49
137	Symetrics, Inc.	158
177	Tru-Flate, Inc.	163
27	Weatherhead Co.	171
	REMOTE CONTROL, HYDRAULIC	
168	Hydronic Corp.	89
	RETAINING PUMPS	
175	Ramsey Corp.	137
	ROD WIPERS, SCRAPERS & ASSEMBLIES	
180	Greene, Tweed & Co.	68
168	Hydraulic Accessories Co.	87
	SERVO COMPONENTS	
1	Hanna Engineering Works	75
129	Weston Hydraulics Ltd.	174
	SERVOVALES	
146	Kearfott Div.	95
129	Weston Hydraulics Ltd.	174
	SHAFTS & GUIDE RODS	
147	Thomson Industries, Inc.	159
	SIGHT GAGES, LIQUID LEVEL	
152	Century Hydraulics	30
181	Federal Brass Mfg. Co.	53
	SLEEVES	
22	A&A Mfg. Co., Inc.	1
	SOLENOIDS	
67	Detroit Coil Co.	44
117	National Acme Co.	117
	SWITCHES	
135	Controls Co. of America	37
	THERMOMETERS	
95	American-Standard Controls Div.	9
172	Marshalltown Mfg., Inc.	109
	TIMERS	
167	Industrial Timer Corp.	91
	TUBE FITTINGS	
5	Anchor Coupling Co., Inc.	10, 11
47	Crawford Fitting Co.	38
96	Flodar Corp.	55
72	Formrite Tube Co.	58
174	L & L Mfg. Co.	99
157	Parker Fittings & Hose Div.	127
26	Weatherhead Co.	170
	TUBING, METAL	
72	Formrite Tube Co.	58
99	Republic Steel Corp.	140
	TUBING, HOSE, PLASTIC	
154, 155	Imperial-Eastman Corp.	90
173	Synflex Products Div.	116
	VALVE CASTINGS	
158	Dalton Foundries, Inc.	40
	VALVES, AEROSPACE	
172	Bodnar & McDermott Mfg. Co., Inc.	26
137	Futurecraft Distribution Corp.	60
	VALVES, INDUSTRIAL	
45	Adel Products Div.	2
74	AquaMatic, Inc.	13
4	Autoclave Engineers, Inc.	15
Cover 3	Automatic Switch Co.	16
171	Auto-Ponents, Inc.	17
148, 149	Barksdale Valves	18, 19
58	Beckett-Harcum Co.	20
8	Bellows-Valvair	22
172	Bodnar & McDermott Mfg. Co., Inc.	26
35	Bruning Co.	27
135	Circle Seal Products Co.	33
93	Commercial Shearing & Stamping Co.	36
97	Denison Engineering Div.	43
158	Fluid Controls, Inc.	56
14	Fulflo Specialties Co., Inc.	59
36	Greenlee Tool Co.	69
165	Herion, Inc.	82
21	Hunt Valve Company	86
103	Hydreco Div.	88
73	Jamesbury Corp.	93
152	Kepner Products Co.	98
174	Manatrol Corp.	179
166	Marshalsea Bros. Ltd.	110
179	Novi Tool & Machine Co.	120
41	Numatics, Inc.	121
106	Racine Hydraulics & Machinery, Inc.	136
168	Republic Mfg. Co.	139
49	Rivett Lathe & Grinder Inc.	142
11	Ross Operating Valve Co.	144
39	A. Schrader's Son	147
33, 34	Skinner Electric Valve Div.	150
52, 53	Vickers, Inc.	166
56	Waterman Hydraulics Corp.	168
27	Weatherhead Co.	171
153	Westinghouse Air Brake Co.	173
31	Wooster Div.	178
	WAY PROTECTORS	
22	A&A Mfg. Co., Inc.	1

READER SERVICE CARD

Hydraulics & Pneumatics

Card Invalid Without Company Name

SEPT. 1961 — Do not use after Dec. 15, 1961

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____ KIND OF BUSINESS (or product manufactured) _____

CITY _____ ZONE _____ STATE _____

ADVERTISERS

1	16	31	46	61	76	91	106	121	136	151	166	181	196	211
2	17	32	47	62	77	92	107	122	137	152	167	182	197	212
3	18	33	48	63	78	93	108	123	138	153	168	183	198	213
4	19	34	49	64	79	94	109	124	139	154	169	184	199	214
5	20	35	50	65	80	95	110	125	140	155	170	185	200	215
6	21	36	51	66	81	96	111	126	141	156	171	186	201	216
7	22	37	52	67	82	97	112	127	142	157	172	187	202	217
8	23	38	53	68	83	98	113	128	143	158	173	188	203	218
9	24	39	54	69	84	99	114	129	144	159	174	189	204	219
10	25	40	55	70	85	100	115	130	145	160	175	190	205	220
11	26	41	56	71	86	101	116	131	146	161	176	191	206	221
12	27	42	57	72	87	102	117	132	147	162	177	192	207	222
13	28	43	58	73	88	103	118	133	148	163	178	193	208	223
14	29	44	59	74	89	104	119	134	149	164	179	194	209	224
15	30	45	60	75	90	105	120	135	150	165	180	195	210	225

NEW PRODUCTS

300	315	330
301	316	331
302	317	332
303	318	333
304	319	334
305	320	335
306	321	336
307	322	337
308	323	338
309	324	339
310	325	340
311	326	341
312	327	342
313	328	343
314	329	344

NEW LITERATURE

400	415	430
401	416	431
402	417	432
403	418	433
404	419	434
405	420	435
406	421	436
407	422	437
408	423	438
409	424	439
410	425	440
411	426	441
412	427	442
413	428	443
414	429	444

AEROSPACE DATA

500	515	530
501	516	531
502	517	532
503	518	533
504	519	534
505	520	535
506	521	536
507	522	537
508	523	538
509	524	539
510	525	540
511	526	541
512	527	542
513	528	543
514	529	544

Card Invalid Without Company Name

SEPT. 1961 — Do not use after Dec. 15, 1961

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____ KIND OF BUSINESS (or product manufactured) _____

CITY _____ ZONE _____ STATE _____

ADVERTISERS

1	16	31	46	61	76	91	106	121	136	151	166	181	196	211
2	17	32	47	62	77	92	107	122	137	152	167	182	197	212
3	18	33	48	63	78	93	108	123	138	153	168	183	198	213
4	19	34	49	64	79	94	109	124	139	154	169	184	199	214
5	20	35	50	65	80	95	110	125	140	155	170	185	200	215
6	21	36	51	66	81	96	111	126	141	156	171	186	201	216
7	22	37	52	67	82	97	112	127	142	157	172	187	202	217
8	23	38	53	68	83	98	113	128	143	158	173	188	203	218
9	24	39	54	69	84	99	114	129	144	159	174	189	204	219
10	25	40	55	70	85	100	115	130	145	160	175	190	205	220
11	26	41	56	71	86	101	116	131	146	161	176	191	206	221
12	27	42	57	72	87	102	117	132	147	162	177	192	207	222
13	28	43	58	73	88	103	118	133	148	163	178	193	208	223
14	29	44	59	74	89	104	119	134	149	164	179	194	209	224
15	30	45	60	75	90	105	120	135	150	165	180	195	210	225

NEW PRODUCTS

300	315	330
301	316	331
302	317	332
303	318	333
304	319	334
305	320	335
306	321	336
307	322	337
308	323	338
309	324	339
310	325	340
311	326	341
312	327	342
313	328	343
314	329	344

NEW LITERATURE

400	415	430
401	416	431
402	417	432
403	418	433
404	419	434
405	420	435
406	421	436
407	422	437
408	423	438
409	424	439
410	425	440
411	426	441
412	427	442
413	428	443
414	429	444

AEROSPACE DATA

500	515	530
501	516	531
502	517	532
503	518	533
504	519	534
505	520	535
506	521	536
507	522	537
508	523	538
509	524	539
510	525	540
511	526	541
512	527	542
513	528	543
514	529	544

H&P IS NOW ADDRESSED LIKE THIS:

IT SHOULD BE CHANGED TO THIS:

MAJOR PRODUCTS MANUFACTURED OR TYPE OF BUSINESS AT THIS ADDRESS _____

MY JOB TITLE _____

SIGNATURE _____

Was this copy of HYDRAULICS & PNEUMATICS correctly addressed? If not, use this card to give us your complete mailing address plus the old (incorrect) one.

FIRST CLASS
PERMIT NO. 8066
CLEVELAND, OHIO

NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

BUSINESS REPLY MAIL

POSTAGE WILL BE PAID BY:

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

FIRST CLASS
PERMIT NO. 8066
CLEVELAND, OHIO

NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

BUSINESS REPLY MAIL

POSTAGE WILL BE PAID BY:

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

FIRST CLASS
PERMIT NO. 8066
CLEVELAND, OHIO

NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

BUSINESS REPLY MAIL

POSTAGE WILL BE PAID BY:

HYDRAULICS & PNEUMATICS
812 Huron Road
Cleveland 15, Ohio

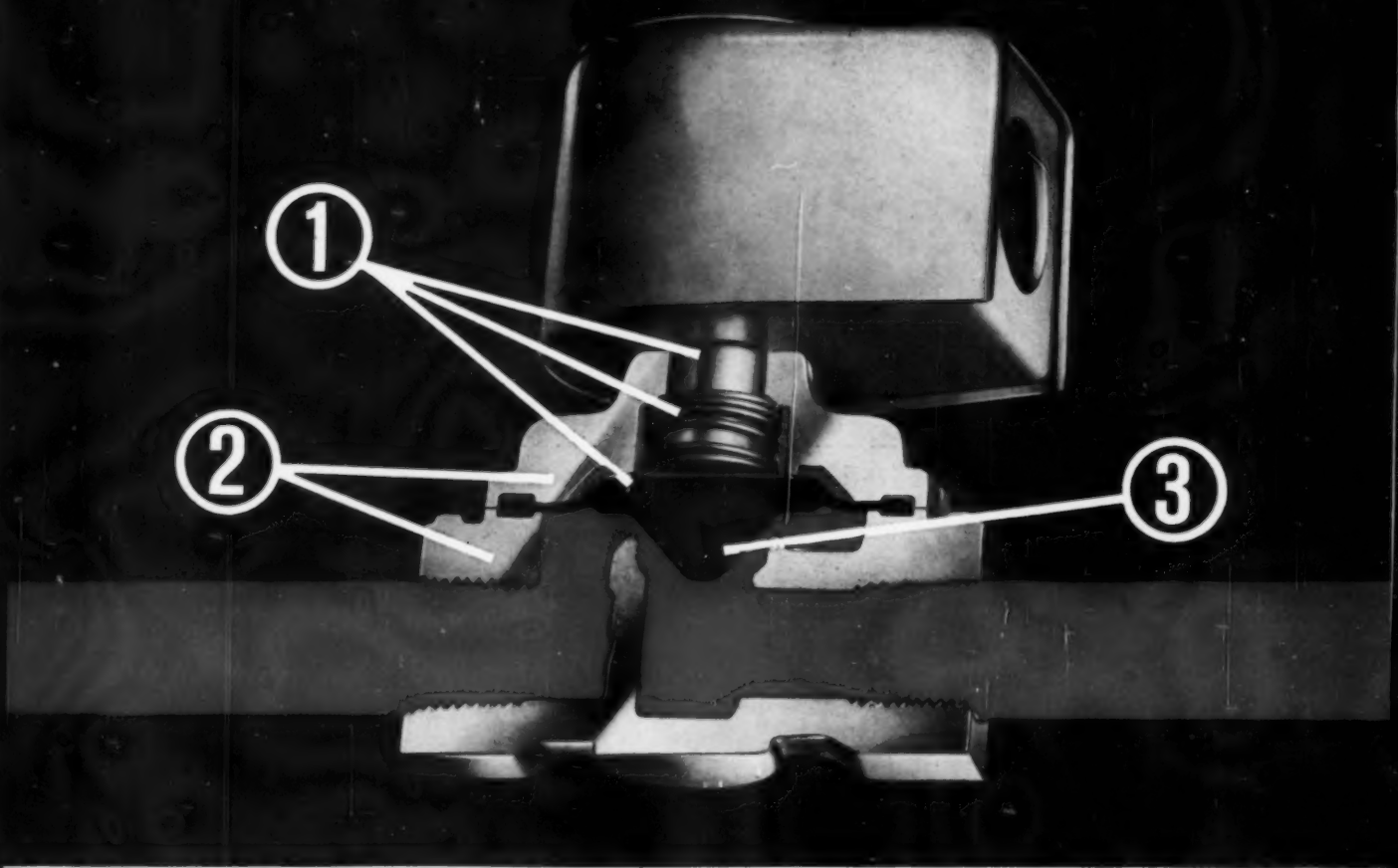
READER SERVICE CARD

Hydraulics & Pneumatics

FOR YOUR CONVENIENCE . . .

to receive further information about products described

SIMPLICITY, RUGGEDNESS, TIGHT SEATING,



WITH ASCO'S COMPLETE LINE OF 2-WAY SOLENOID VALVES

ASCO general purpose packless valves are now provided in a full ⅜" to 3" range . . . handle pressures up to 350 p.s.i. . . . ½" and ¾" sizes available to 1500 p.s.i. . . . provide dependable flow control for air, gas, water, light oil and other non-corrosive fluids.

Check these features of the Bulletin 8210A:

1. **Simplicity** in construction: Only three operational parts: all stainless steel core, stainless steel spring. Hycar diaphragm, ⅜"-¾" sizes . . . bronze piston ¾"-3" sizes.
2. **Ruggedness:** Forged brass bonnet and body insure freedom from porosity.
3. **Tight shut-off:** Assured by resilient disc construction.

Compactness: 2¾" face to face; 3¼" pipe center line to top of solenoid; 3-13/16" overall height. (Normally closed, ⅜" x ½" sizes.)

Mountable in any position: Normally open or normally closed.

Fast action: Rapid filling-venting operation permits cycling rate to 400 per minute.

All sizes have full area ports, continuous duty coils designed for low temperature rise and long life, and are available normally open or normally closed with standard, water tight or explosion proof solenoid.

Whatever the crucial factor in your flow-control application – reliability, compactness, high cycling rate – there is an ASCO valve that meets your need.

For Immediate Delivery . . .

World's largest stock of Solenoid Valves. A complete Solenoid Valve Stock List will be sent to you with your copy of Catalog No. 202.

New! Catalog No. 202 covers the ASCO line of Solenoid Valves. Write for your copy today.

ASCO Valves

Automatic Switch Co. 50-B HANOVER ROAD, FLORHAM PARK, NEW JERSEY, FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

ASCO

Circle **16** on Reader Service Card

want a peek

at

the new models?

Here's your personal invitation to examine the newest and most significant fluid power products. HYDRAULICS & PNEUMATICS unveils new models 12 times a year in its New Products department. A staff of editors that knows the fluid power field constantly reviews the many new products announced each month. They pick the best and present them for your inspection and evaluation. After you have looked them over, you can follow up for complete details by using the Reader Service Cards bound into every issue. Just circle the appropriate numbers, fill out the cards completely, drop them in the mail. We'll do the rest.

Hydraulics & Pneumatics

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

812 HURON ROAD • CLEVELAND 15, OHIO • SUPERIOR 1-9620

OFFICES: NEW YORK • CHICAGO • LOS ANGELES • LONDON

Franchise Circulation gets magazines to the men who buy

Distilled Writing gets magazines read

THE MAGAZINE OF FLUID POWER

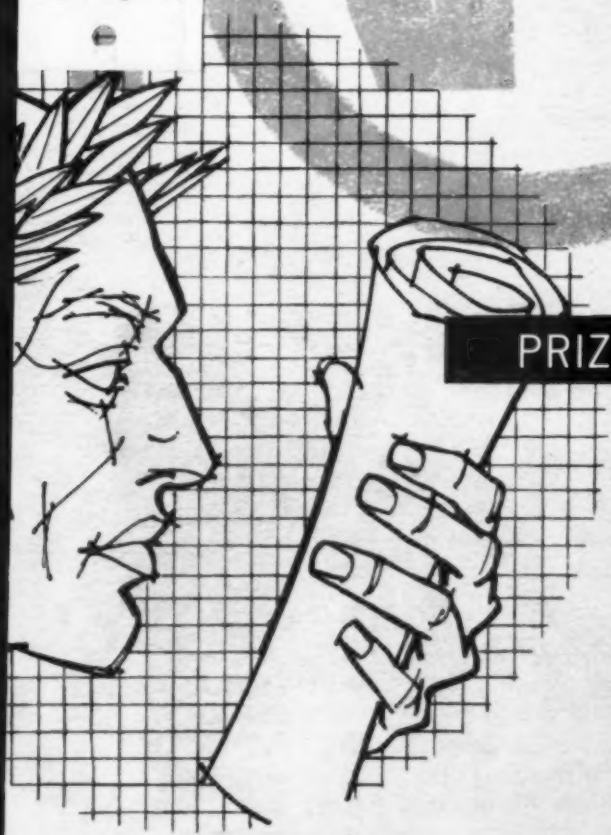
Hydraulics & Pneumatics

OCTOBER 1961

EDITORIAL DEPT
UNIVERSITY MICROFILMS
313 NORTH FIRST ST. INC.
ANN ARBOR MICH
950500 A1-1-8221

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS

Special Report Featuring Program and Abstracts



PRIZE PAPER CONTEST AWARDS 1961

1. Interlocking Air Circuits for Reliable Sequencing
2. Techniques for Designing Airborne Components
3. Closed Circuit System Powers Tractor's Hydraulics

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE